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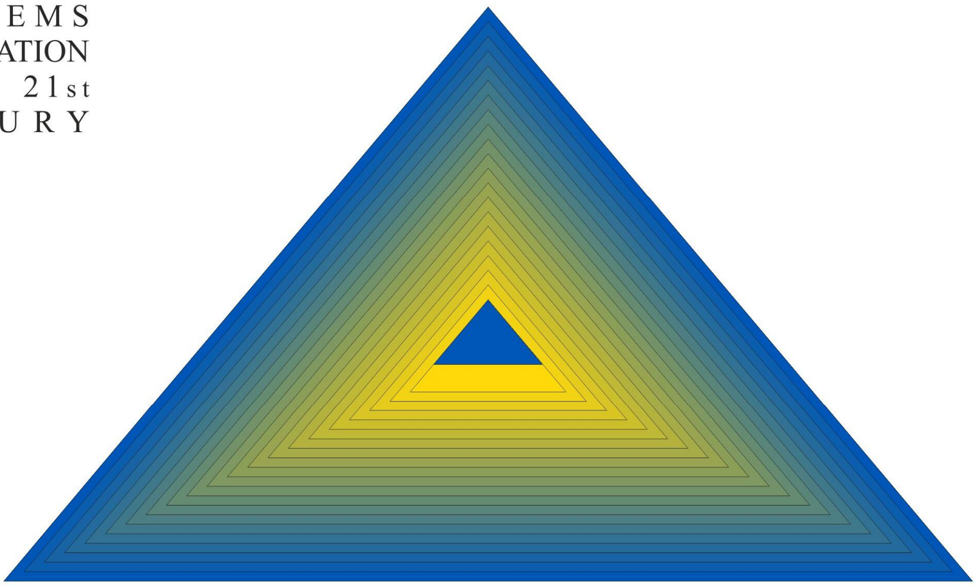

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THE ESSENCE OF MIND STRATEGY IN THE RELATIONSHIP WITH NATURE: HUMAN-NATURE-WISDOM UNITY

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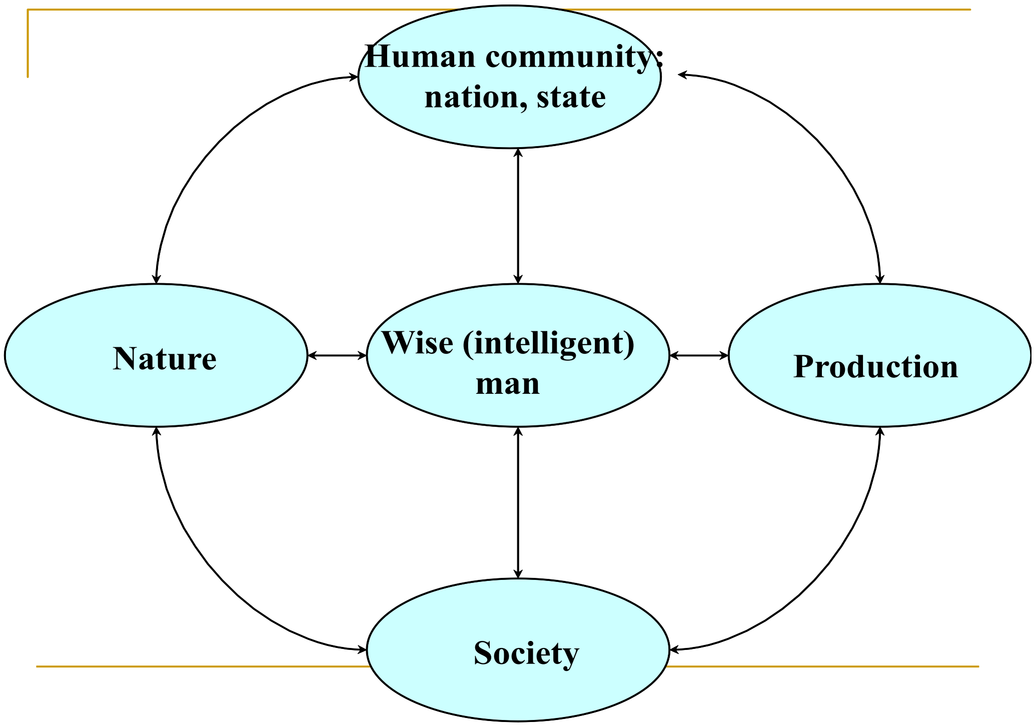
Natural science and technology education is undoubtedly an important area of general education. Living in the 21st century, which is often referred to as modern biology, chemistry, physics, etc., age, and the age of constantly improving technologies, it is impossible to act without sufficient education in this field (Lamanauskas, 2023a). It is generally undeniable that education is a complicated and complex system. Moreover, it is an integrated and integral system of teaching and learning at different levels and in different contexts. In the public academic educational discourse, the need to search for modern teaching and learning methods is constantly expressed so that educational institutions can better respond to the changing educational needs of learners and society (Lamanauskas, 2023b).

Figure 1
Human-Nature-Wisdom Unity



It is obvious that partial images of the world (physical world, chemical world, biological world, etc.) are fragmentary and weakly related to each other; they affect our consciousness as a stream of separate images. Therefore, it is necessary to form a system of accumulated knowledge of all natural subjects, establishing interdisciplinary connections, integrating the knowledge of natural science subjects, forming a coherent worldview, returning to one world for all. Thus, in order to deeply know and understand the environment and nature, to understand the relationship between phenomena and laws existing in it, and to be able to navigate in nature at today's level of scientific knowledge, both the differentiation of natural sciences and the integration of these sciences are equally important: the restoration of the "dismantled" nature as a unified system at a much higher theoretical level of knowledge. Philosophy, based on the empirically collected and summarised data of natural and social sciences and the propositions devised a priori by philosophers, makes generalised conclusions about man, nature, man's place and his role in nature and society. This is where the necessity of systematic thinking (approach) comes from when implementing science education. Systems thinking helps learners understand the connections between different fields of natural sciences and complex phenomena. The result of such an approach is wider knowledge and helping learners to understand how various phenomena are related to each other. This is not only an academic aspect but a much more important thing, i.e., the development of students' ability to apply their knowledge in practice. Thus, systems thinking should be used as a teaching and learning tool (Broks, 2016; Chandi, 2008; Knipples, 2003; Shaked & Schechter, 2013).

A systematic approach requires combining the knowledge of related subjects (e.g., natural sciences) into a whole and making conditions for the learners to research, draw conclusions, process abundant and diverse information, improve and change, complete their knowledge, i.e., eliminate common/traditional subject barriers, refuse narrow empiricism. The field of science education is wide, complex and diverse. It is not only the transmission of natural science knowledge but also ecological, environmental, antidrug, sexual, antinicotine education, healthy lifestyle training, etc. Today's society is dealing with very relevant issues of nature protection, nature conservation, ecology, environmental protection, and other problems. All this requires a new approach from all of us, the efforts of various field specialists, eliminating all separating barriers. Global problems are a common concern for all of us. This is just because not a single problem is isolated from another, most of them are intertwined, fully determined, united in their nature. Therefore, knowing (clarifying) connections is complicated and hardly achievable. Their solution is possible only when they are comprehensively analysed by closely linking them together.

The strategy of mind in the relationship with nature primarily defines the attitude and plans of all of us and each of us (individual, community, organization) related to nature and the surrounding environment. This strategy combines both social, political and educational aspects in itself. Naturally, the role of education is extremely important as it helps to increase awareness about the importance of nature and forms and promotes a sustainable way of life and activity. We mentioned sustainability not without a reason. Many different organisations are trying to incorporate sustainability principles into their strategies. Sustainability is primarily associated with responsible use of natural resources, waste reduction, energy efficiency, etc. From the point of view of education, this means an extremely significant thing, namely education for sustainable development. The importance of education for sustainable development is unquestionable. And such education should be developed from an early age. However, this requires proper preparation of pre-school and primary education teachers in the field of UDV. Researchers note that sustainable development is primarily determined by the intellectual and cultural potential of the society, therefore, education has a special role (Adomaitienė et al., 2006). Education for sustainable development must inevitably become a certain frame of mind (Bonnett, 2002).

The relationship between nature and man is becoming more and more problematic. Man can no longer be treated only as a component of the biosphere. It is necessary to examine together (systematically) nature and society development; in other words, mind strategy is necessary for the relationship with nature, society, and the technogenic environment (to live harmoniously, responsibly and understandably) (Figure 1). It can be conditionally said that nature "created" man, man – technology (technogenic environment), and the latter "turned its back" both against nature and against man himself (Lamanauskas, 2003). How not to get lost? It can be assumed that one of the essential goals of the mind strategy in the relationship with nature is to form and maintain a harmonious long-term approach when both individuals and organizations (communities) will be able to exist harmoniously thus contributing to sustainable development.

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EVALUATION OF THE CRITICAL THINKING SKILLS OF SECONDARY SCHOOL STUDENTS IN SAUDI ARABIA

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Abstract

The present study examined critical thinking (CT) and its importance in Saudi secondary education. The sample included upper-secondary students and teachers in Riyadh, Saudi Arabia's capital and largest city. Qualitative and quantitative methods were used to study students' CT skill development, barriers to growth, instructors' views on CT advancement, and students' views on their CT skills. The study examines secondary school students' critical thinking development and impediments. It also examined teachers' perceptions of their students' progress in CT. The research collected quantitative data from 374 questionnaires and qualitative data from eight interviews*. SPSS performed regression analysis on survey quantitative data. A thematic analysis was employed to evaluate qualitative interview data. The quantitative findings from the surveys revealed uneven CT skills. The findings also showed that gender, Grade Point Average (GPA) and family background affect CT. The qualitative findings from the interviews with the teachers stressed the importance of collaborative programming and active student engagement in classroom activities to foster CT. Bullying and peer pressure hindered autonomous and CT, making it difficult for instructors to motivate and support students. The findings emphasised the importance of teachers in creating a safe learning environment and encouraging analytical thinking. Recommendations for improving CT in Saudi secondary education were proposed addressing several critical aspects of CT advancement, including curriculum development, teacher training, parental involvement, government-led extracurricular learning, teacher-student interactions, and gender equality in CT advancement. This study could help Saudi students develop CT skills to meet the challenges of the modern world.*

Keywords: *critical thinking (CT), mixed-methods research, Saudi Arabia, secondary education, teacher-student interaction*

Introduction

The application of critical thinking (CT) in education can facilitate students' comprehension of and engagement in analytical discourse and problem-solving activities. During academic activities in a classroom setting, students and professors may engage in intellectual discourse and initiate debates. CT acquisition and utilisation can enhance students' performance of routine tasks, enabling them to assume additional responsibilities. Henry Giroux, a prominent scholar in the field of critical theory, has contributed significantly to the domains of learning and education in the United States. Giroux (1978) emphasised the importance of CT in education as it can also help students to challenge oppressive systems. Freire (1970) also underscored the vital role of education in challenging systems of oppression and subjugation. He held that education has the potential to empower marginalised and oppressed people. Emancipation is attained through the facilitation of dialogue, wherein the student assumes an active role in the educational journey and the instructor places significance on students' perspectives and contributions. This approach to education can provide exceptional opportunities for learning and development, as well as help students question what they see as oppressive structures in society, including in educational arenas.

Brookfield (2005) asserted that the incorporation of CT into the field of education holds significant importance. This educational approach can equip students with the necessary skills to effectively adapt to unpredictable circumstances and successfully navigate rapid shifts in social, economic, and technological landscapes. Rodzalan and Saat (2017) showed that CT skills contribute to students' acquisition and evaluation of novel information, something which has a wide range of practical uses and advantages outside of the educational sphere. The advantages of CT, in short, stretch far outside the borders of the classroom. To cultivate CT, it is imperative to incorporate this cognitive process into various aspects of academic endeavours, such as courses, projects, collaborative work, and individual assignments.

Problem Statement

In order to mitigate the apprehensions surrounding the scholastic achievement of Saudi Arabian students in the domain of CT abilities, it is imperative to analyse the recent modifications to the nation's educational framework and its strategic objectives. Acknowledging the significance of enhancing students' CT capabilities, the Saudi government has placed primary and secondary education as a top priority (Allmnakrah & Evers, 2019; Dinham & Rowe, 2008; Topping, 2011). Notwithstanding these endeavours, apprehension persists regarding the scholastic achievement of Saudi students' CT skills (Moshashai & Bazoobandi, 2020). The swift evolution of the nation's educational system and its strategic plans, which require the utilisation of current and pertinent resources, amplify this concern.

Concerns have been raised by the Saudi Ministry of Education and education experts regarding the calibre of teaching and the necessity for educators and students to acquire more advanced proficiencies (AlNajdi, 2022). As a reaction to these apprehensions, the government has allocated additional funds towards social and economic progress. These funds are currently being utilised to support educational programmes that explore novel approaches in the fields of information technology, professional development, and information systems (Allmnakrah & Evers, 2019; Tayan, 2017). Furthermore, in Saudi Arabia, recent policy measures pertaining to children with disabilities have prioritised their integration into regular educational institutions, demonstrating a dedication to catering to the varied educational requirements of this population (Abu-Alghayth et al., 2022).

It is essential to identify specific challenges and develop targeted solutions in collaboration with parents and other stakeholders in order to guarantee the academic success of students (Allmnakrah & Evers, 2019). The aforementioned collaborative approach is consistent with the imperative for a paradigm shift in the Saudi education system, specifically in the execution of the country's wide-ranging 'Vision 2030', which underscores the significance of teacher input, professional development, and the cultivation of critical thinking skills as critical factors for achieving future prosperity (Allmnakrah & Evers, 2019).

In addition, it is imperative to conduct an extensive statistical analysis of the test results of students in order to establish a solid basis for a meticulous exploration of the elements that contribute to the below-average academic achievements of Saudi students in international comparisons and to devise possible solutions (Allmnakrah & Evers, 2019). The present inquiry will employ the latest and most pertinent materials at its disposal, comprising official documents pertaining to educational strategic plans and Ministry of Education resources, in addition to web-accessible research from Saudi universities that offers significant insights into the present condition of education in Saudi Arabia (Allmnakrah & Evers, 2019).

A multifaceted strategy is necessary to tackle the issues surrounding the scholastic achievements of Saudi Arabian students in CT skills. This strategy should involve engaging stakeholders in the decision-making process, allocating financial resources towards educational improvements, and conducting an exhaustive statistical analysis of students' test results. The forthcoming modifications in the educational system and the nation's strategic blueprints, in addition to the resources accessible from credible sources like the Ministry of Education and Saudi universities, ought to inform these endeavours.

The issue that this study aims to explore is the perceived inadequacy of CT abilities among Saudi Arabian secondary school students. In spite of the recognition of the significance of CT and the government's emphasis on education as a priority, there is concern that students' CT abilities are not progressing as anticipated. The significance of this issue lies in the fact that students' academic achievements and their capacity to participate in intellectual dialogues and resolve challenges are heavily reliant on their CT abilities.

The primary aim of this study was to acquire an all-encompassing comprehension of the condition of CT abilities among secondary school students in Saudi Arabia. This entails examining the methods by which these abilities are nurtured, discerning the obstacles and determinants that impede their growth, and delving into the viewpoints of educators and learners regarding this matter.

Research Aim and Objectives

The present study aims to understand the development of critical thinking skills among secondary school learners. To achieve this aim, the study has the following objectives:

- To explore how secondary school learners develop their critical thinking skills;
- To identify the challenges and factors that hinder the development of students’ critical thinking skills;
- to explore the viewpoints of teachers regarding the progress of students’ CT abilities;
- to explore students’ perspectives on CT and the extent to which they have developed this skill set.

By providing an in-depth comprehension of the current state of the development of CT skills in secondary institutions in Saudi Arabia, these questions will aid in resolving the issue and accomplishing the research's objective. In order to more effectively cultivate students’ CT skills, possible modifications to pedagogical approaches and policy may be influenced by the results of this study.

Education Policy in Saudi Arabia

Saudi Arabia’s four-stage education system mandates formal schooling for children aged six to 18. Primary school, which provides students with a foundation in basic subjects, begins at age six and continues through age 12. Students aged 13 to 15 attend lower-secondary school, which bridges the gap between primary and secondary education. Upper-secondary school, which lasts from ages 16 to 18, offers a more specialised and comprehensive curriculum that prepares students for college and/or the workforce. This educational journey equips students with essential knowledge and skills for future success. Upper-secondary school, which typically commences at the age of 16 and 18, is the culminating phase of formal education. Its objectives are to equip students with the necessary skills for employment or to prepare them for tertiary or adult education. Typically, upper-secondary school offers a broader selection of subject options and streams (Al-Shumaimeri, 1999). Gender segregation starts in fourth grade and continues through upper-secondary school, with only female teachers working in girls’ schools and male teachers in boys’ schools.

Saudi Arabia's education policy aligns all levels of education with the nation's socioeconomic and cultural needs (Alshaer, 2008). The policy aims to equip students with modern knowledge and skills for national and global development, recognising education's crucial role in infrastructure development. The government's strategic plans, including the five-year, 10-year, and Saudi Vision 2030 initiatives, prioritise social and economic growth (Alomi et al., 2021; Kosárová, 2020). However, cultural and political constraints have led to a more conservative approach, hindering cognitive development, moral standards and CT among students. These challenges include traditional teaching methods, such as rote learning and teacher-centred instruction, large class sizes and insufficient support from school administrators and teachers in promoting CT. In addition, the majority of the curriculum prioritises – and rewards - memorisation over comprehension.

Concept of Critical Thinking

According to the literature, CT relies on context; hence, there is no single definition of it. Educators employ the term 'critical thinking' to delineate modes of cognition, analysis, and learning which surpass mere rote memorisation and recollection of facts and information. It is a broad concept that encompasses numerous learning acquisition methods and a great deal of mental processes. CT, as defined in educational theory, is a mode of cognition that generates potential solutions to problems through the use of deliberative reasoning and objective examination of information.

CT is a pivotal notion within the realm of education, inspiring educational reforms that advocate for schools to prioritise lifelong skills applicable across all academic disciplines, professional environments, and civic engagements (Halpern, 2011). Lai (2011) asserted that years of experience, feedback, evaluation, and teachers' perceptions of students' learning have an impact on teaching approaches, communication skills, and CT (Halpern, 2011). Students are able to improve their academic performance by organising, analysing, and completing assignments with the aid of CT. Education, psychology, and philosophy have all considered the concept of CT (Paul, 2005). In education, teaching approaches, communication skills and CT are affected by years of experience, feedback, evaluation and how teachers perceive students' learning (Lai, 2011). CT helps students organise, analyse and complete assignments, boosting their academic performance (Paul, 2005; Phan, 2010). It also improves the thought process of students so that they can grasp course requirements and soak up course material faster (McGregor, 2007). In contrast, explaining and fixing a problem encourages students to respect CT. In addition, Lovatt (2014) noted that prior knowledge and experience can impact how individuals interpret and implement CT skills. In order to ensure optimal student development, it is crucial to strike a balance between practical application, prior knowledge, and CT.

Bloom (1956) proposed six learning modes to conceptualise CT: 1) reading and remembering numbers, faces and processes; 2) engaging in secondary comprehension to understand and illustrate facts; 3) applying generalised facts to other settings and situations; 4) analysing and understanding facts for problem-solving; 5) synthesising and making connections between workplace elements; and 6) gaining knowledge. According to Bloom (1956), CT skills are important for analysing, synthesising, and evaluating information, however, he posited that these skills may not be essential for the acquisition of core knowledge, secondary understanding, and application. As he (1956) pointed out, CT skills can be a valuable tool for overcoming learning obstacles. However, he warned that students may encounter criticism if they employ CT to challenge societal norms, cultural traditions, and rituals. While CT skills are useful for certain cognitive tasks, Bloom thus acknowledged that when these skills are applied to challenge established norms, social problems may result. In short, although CT skills can help students to think independently and challenge existing ideas and beliefs, if students are not careful, they may encounter criticism or even a backlash from their peers, teachers, or family members for not conforming to societal expectations.

The academic discourse surrounding CT underscores its expansive nature, which incorporates a multitude of cognitive processes and learning acquisition strategies, and its crucial function in stimulating reforms in education. As part of the broader educational reforms, the recent changes in the Saudi educational system, specifically the implementation of the Vision 2030, highlight the significance of developing CT skills (Allmnakrah & Evers, 2019). In order to achieve the objectives outlined in Vision 2030, a fundamental transformation of the Saudi education system is required (Allmnakrah & Evers, 2019).

Developing Students' Critical Thinking Skills

The cognitive capabilities of upper high schoolers were highlighted by Adeyemi (2012) in the pursuit of cultivating CT skills, asserting that they possess a greater capacity to examine theories. In order to effectively engage in CT, Nigerian secondary school students should possess higher cognitive abilities, which include problem-solving, synthesis, and text evaluation. Furthermore, Adeyemi highlighted the facilitative role of CT, which involves inquiry and fact-based reasoning, in children's learning process. To enhance CT skills, Adeyemi suggested that students might consider addressing personal issues, such as biases or preconceptions, recognising that individual perspectives affect CT. The researcher also stressed that real-world experience is an important catalyst for the development of cognitive skills. As well as learning CT in the classroom, children have the opportunity to engage in a wide variety of other environments, including the home and social settings.

Factors Affecting Students' Critical Thinking Abilities

A comprehensive examination of CT abilities among students reveals multifaceted influences, as observed in a study on Indonesian and Hong Kong student populations by Mawaddah et al. (2018). The scholars' qualitative study of male and female students demonstrated proficiency in articulating and analysing issues in the students' native language. However, a notable gender disparity was observed, with male students adopting fewer appropriate solutions than their female counterparts. Mawaddah et al. (2018) posited that female brains have more efficient neuron circuits, which organise brain connections, than male brains. As a result of this intriguing biological insight, conventional views of cognitive capability have been challenged. Nevertheless, the specific factors contributing to the superior performance of female students remain unclear, and further research is needed.

Culture plays a pivotal role in the development of CT skills, as Rohmani and Kusuma (2016) highlighted in their study of the influence of Indonesian culture on CT. Unlike industrialised nations, where CT abilities are prioritised over rote memorisation, Indonesian culture emphasises explanations and information. In addition to this insight, by examining CT through the lenses of family history, cultural nuances, and preferred learning methods, Rohmani and Kusuma (2016) demonstrated that low levels of CT can be attributed to limited mastery of a second language.

The impact of parental roles on students' CT abilities was examined by Cheung et al. (2001) in Hong Kong. This study showed that fathers' and mothers' occupations are significantly positively correlated with the development of their children's CT. Interestingly, paternal work status seemed more influential than maternal work status. In contrast, maternal education did not seem to have any discernible effect on students' CT abilities.

Furthermore, it is crucial to take into account the evolving Saudi educational environment, the gender disparities and cultural influences that continue to impact students' CT abilities. In the context of the evolving educational landscape in Saudi Arabia, the studies of Rohmani and Kusuma (2016) and Cheung et al. (2001) regarding the impact of parental roles on students' CT abilities and the influence of culture on critical thinking, respectively, are especially pertinent.

The Teacher's Role in Fostering Critical Thinking Skills

Teachers play an obvious and important role in shaping students' behaviour and cognitive development (Massa, 2014; Pajares & Kranzler, 1995). According to Massa (2014), teachers should encourage students to develop and defend ideas by assigning math problems and writing tasks-an approach that is dependent upon an instructor's confidence in his or her students' ability to develop and defend ideas. Pajares and Kranzler (1995) emphasised the importance of teachers trusting their students and encouraging them to think critically and expand their horizons.

Slameto (2017) emphasised the role of teachers as change agents driving school reforms, with the aim of improving both students and schools. By encouraging students to participate in class and participate in group work, teachers are able to influence their minds, reshaping their perspectives on their futures, and Saudi Arabia is no different.

Effective education in CT depends on teachers' comprehensive understanding of the concept, coupled with continuous professional development (Gokhale, 1995). A critical component is cognitive function, with Gokhale advocating for instructors to attend professional development courses that cover CT skills, including reasoning, judgment, decision-making, analysis, and evaluation of information.

Brookfield (2011) underscored the importance of teacher role modelling in the classroom. The purpose of this activity was to share personal examples of CT engagement and to examine assumptions. In Brookfield's view, teachers should encourage CT by providing evidence that students have previously accomplished such tasks. The purpose of class activities should also be explained to students in order to build trust and confidence. Students who believe their instructor has a well-defined strategy are more likely to complete activities with clear objectives (Brookfield, 2011).

Moreover, within the framework of educational reforms, the significance of educators' assistance in cultivating CT abilities cannot be overstated. Gokhale (2021) has underscored the importance of teachers maintaining a consistent professional development programme and acquiring a thorough comprehension of CT. This has correlated with the current endeavours to reform the Saudi education system and incorporate CT abilities into pedagogical approaches.

Barriers to Students' Critical Thinking Development

Effective cultivation of CT faces significant challenges in environments characterised by conservative political climates and resistant cultures. Cultural barriers, which encompass family and community values, have a profound impact on beliefs and ways of life. It is this type of situation that hinders the integration of the school and students into the broader community. In the absence of such cultural capital and a conducive socio-political context, communication and CT in education are rendered obsolete. Educational systems must promote healthy debates in order to foster a conceptual understanding of sociology, particularly challenging patriarchal and authoritarian social structures that inhibit student and teacher expression (Giroux, 1978).

A strong knowledge base and intrinsic motivation are also necessary for empowering individuals to think critically. Partial domain specialisation, however, can hinder analytical thought in domains where citizens rely on representatives, such as politics. Those who have extensive knowledge of economics may have difficulty analysing political issues objectively, for example. Paul and Elder (2001) suggested that partial domain specialisation may encourage citizens to think objectively rather than analytically, especially in areas where trust in representatives is paramount. As a result of political restrictions, students are further limited in their ability to express critical thoughts and utilise existing knowledge.

Cotton's (1991) study foresaw that despite new thinking paradigms among students, strengthening CT skills would be challenging in the 21st century. Educational, sociocultural, and political structures are crucial to addressing such challenges. According to Larsen (2002), the primary challenge in teaching critical thinking lies in difficulties associated with curriculum development due to the need for trained instructors, curriculum developers, and sufficient time. Alfani (2013) found that Nigerian teachers struggle to incorporate CT into classroom lessons and assessments. Ilyas (2015) found that Indonesian teachers lack a deep understanding and application of CT. Overall, these findings indicate that the primary challenge to cultivating CT skills in students lies in addressing teachers' lack of competence in the area. This necessitates specialised training for educators to effectively comprehend and teach CT. This is the initial step toward fostering an upcoming generation of 'critical thinkers'.

In addition, cultural and political obstacles that impede the development of students' CT are germane to the Saudi educational system. Particularly in the context of Vision 2030, the imperative to overcome cultural barriers and encourage constructive discourse in order to cultivate CT is consistent with the objectives of educational reforms in Saudi Arabia (Essa & Harvey, 2022).

Research Methodology

An examination of student CT skills as well as teacher perspectives at upper secondary schools in Riyadh, Saudi Arabia's capital and largest city, was the focus of the present study. The study examined the relationship between students' CT skills (the dependent variable) and their personal and familial backgrounds (independent variables). The study targeted six schools–three for boys and three for girls–to collect data. It employed 374 questionnaires and eight interviews for quantitative data collection, analysed using SPSS regression analysis, and used thematic analysis for the interview data.

As shown in Table 1, 28% of the students are in their first year, 34% in their second year, and 38% in their third year.

Table 1
Student Distribution by Year of Study

Year of study	Percentage
First year	28
Second year	34
Third year	38

Assessment of Critical Thinking Competencies

The literature indicates a correlation between CT competencies and the propensity for control and proactivity within educational settings and daily life scenarios, underscoring the significance of these skills (Rohmani and Kusuma, 2016). The assessment of CT in primary and secondary education continues to be a contentious issue. While some theorists posit that the evaluation of these competencies is feasible, a consensus on standardised methodologies is lacking (Munkebye & Gericke, 2022). It has been proposed that the development of assessment tools incorporating various items to encapsulate CT may be beneficial (Miller & Cohen, 2019). In this study, a novel metric consisting of 25 items will be used to assess students' CT skills, which was developed by Stupple et al. (2017).

Paradigms of Positivism and Interpretivism

Positivism tends to be associated with deductive methodologies, whereas interpretivism tends to be associated with inductive methodologies. A qualitative methodology is indispensable for exploring novel research inquiries, while quantitative methodologies are essential for developing and testing theories and hypotheses (Taylor, 2015). Inductive reasoning, in contrast to the deductive paradigm, begins with observations leading to the development of a hypothesis, which is then subjected to empirical testing (Evans, 2016). The limitations inherent in both positivist and interpretivist frameworks can be mitigated through mixed-method research, thereby leveraging the strengths of both approaches (Green & Johnson, 2017). The current literature review establishes that CT can be effectively examined through both quantitative and qualitative research techniques. Among the more notable quantitative investigations of CT are those conducted by Chaipichit et al. (2015), Chattuchai et al. (2015), and Rodzalan and Saat (2017). As part of the qualitative component of this study, semi-structured interviews were conducted with educators in order to gain insight into their perceptions regarding the integration of CT within the national curriculum and to identify potential barriers to this integration.

Recruitment Strategy

The research focused on upper-secondary school students and teachers in Riyadh, Saudi Arabia. A digital survey was disseminated via email to the children’s parents, utilising a purposive sampling strategy. The survey, designed to gather quantitative data from students, probed the nexus between student background characteristics and the development of their CT skills. The survey methodology facilitated comprehensive data collection, which was subsequently analysed employing both descriptive and inferential statistical techniques. The survey instrument, which demonstrated both reliability and validity, comprised closed-ended questions with Likert-scale responses. Additionally, an interview protocol was established to capture teachers' perspectives on critical thinking proficiency.

Analysis of Quantitative Data

The quantitative data were analysed with SPSS version 25, applying both descriptive and inferential statistical methodologies. Techniques such as cross-tabulation, the Mann-Whitney U test, the Kruskal-Wallis test, and multiple linear regression were utilised to elucidate the relationships between CT skills development among students and their personal and familial backgrounds.

Dependent and Independent Variables

The dependent variable under consideration was students’ critical thinking ability. Independent variables included gender, study section, grade point average (GPA), and the educational levels of the students’ fathers and mothers.

Dummy Variables

During regression analysis, categorical independent variables were converted into dummy variables, with a value of one for presence and zero for absence. In addition to gender (1 for males, 0 for females), GPA, year, specialty, and parents' educational and employment background, this was applicable to many variables.

Interview Transcription

All interviews were audio-recorded, transcribed verbatim, and thematically deconstructed to identify predominant themes. The findings present the results of this process of abstraction and transformation of qualitative data.

Thematic Analysis

Qualitative data analysis can be conducted in several ways, such as through thematic or content analysis. Based on the prevalence and context of specific lexicons within textual data (Krippendorff, 2018), specific lexicons can be assessed within textual data. Conversely, thematic analysis does not focus on quantifying words or themes, but rather elucidating emergent ideas and conceptualisations derived from interview transcripts. By identifying and examining salient themes, researchers are able to distill the basic meaning behind the data (Braun & Clarke, 2012).

Research Results

Quantitative Results from the Student Surveys

Regarding gender, 55% of the students were male and 45% were female. As such, there were no significant differences in gender among the participants. Table 2 shows that 79% of the students focused on the sciences, while 21% specialised in the arts. The maternal and paternal education levels of the students are similar.

Table 2
Distribution of Students Arts and Sciences

Field of study	Percentage
Arts	21
Sciences	79

The distribution of the students by the educational attainment of their fathers is depicted in Table 3. The educational levels are denoted on the x-axis by the following labels: secondary, diploma, bachelor, and postgraduate. The y-axis represents the proportion of students at each of these educational levels. A significant proportion of students have fathers with a secondary education (35%) or a bachelor's degree (38.6%). A smaller proportion of students have fathers with a postgraduate education or a diploma, accounting for 11.8% of the total.

Table 3
Distribution of Students by the Educational Levels of their Fathers

Fathers' Qualification	Percentage
Secondary School	35
Diploma	14.6
Bachelor	38
Postgraduate	11.8

Table 4
Distribution of Students by the Educational Levels of their Mothers

Mothers' Qualification	Percentage
Secondary School	42.1
Diploma	18
Bachelor	36.3
Postgraduate	3.6

A significant number - 52.1% - of the student cohort demonstrated proficiency in identifying inappropriate emotive language within scientific arguments as a result of the evaluation of their CT abilities. Nevertheless, it is concerning to note that 31.1% of the students were unable to demonstrate their ability to demonstrate this particular CT skill or perform unspecified tasks. Furthermore, 82.3% of the students demonstrated a capacity for independent CGT through the development of well-defined aims and objectives. Despite this, it is evident that students would benefit from heightened awareness of the necessity of CT in understanding and analysing concepts, especially within the realm of psychological issues. In the survey, 42.2% of students acknowledged that CT was critical to academic success, while the remainder disagreed. Impressively, more than half of the participants effectively showcased their CT skills through writing, contrasting with a minority that struggled in this regard. Furthermore, 42.2% of the respondents perceived CT as a prerequisite for higher education, whereas 17.5% were uncertain about its importance.

Over 80% of the students expressed the need to enhance their CT skills for quicker assignment completion. They were eager to seek additional materials beyond the curriculum to support their CT skills. All of them were eager to search for materials not in the curriculum to help them think critically. Over one-third considered themselves competent critical thinkers, approximately 40% saw CT as a necessary component of higher education, compared with 35.1% who disagreed. The former attributed the necessity of CT to their ability to manage their higher education without the need to rely solely on memorization and rote learning.

A discerning 42.4% of the respondents reported developing CT skills as they progressed along their academic journey. However, 44.8% expressed scepticism regarding the necessity of developing CT in academic pursuits. As a result of this sentiment, a significant portion of the student population did not demonstrate adequate CT skills. A substantial number of students believed that honing CT skills could potentially enhance their performance in examinations. The student body also indicated that many students required assistance in analysing novel information, evaluating arguments, and comprehending the interconnections among variables. None of the surveyed students acknowledged possessing a focused systematic way of thinking, contrasting starkly with the 80% majority who said they had yet to develop such skills. Another 20% of the students remained neutral or unaware of their thinking approach, signalling a lack of conscious engagement with cultivating CT tools. This collective response suggests that a significant proportion of students are not equipped with the necessary cognitive skills for CT.

On the broader spectrum of CT abilities, a notable 84.5% of the respondents demonstrated the essential cognitive skills required for critically evaluating and analysing both positive and negative aspects of a subject or situation. However, it is concerning that 5% indicated a need for further development in this capacity. A distinct observation emerged when assessing CT skills in the context of reading – only 36.2% of the students exhibited proficiency. This finding underscores a deficiency in the reading capabilities of secondary school students in Saudi Arabia.

More than two-thirds of the students demonstrated proficiency in CT in terms of restating others' ideas. However, 19% acknowledged that they lacked this ability, and 15.8% expressed uncertainty regarding their level of mastery in this regard. It is worth noting that although 43.3% of the students in the classroom self-identified as critical thinkers, the remaining students formed two distinct categories. 24.7% of the student population, or the first group, possessed the knowledge that they were devoid of this particular attribute. It was determined that the second group, comprising 31.9% of the students, lacked this skill irrespective of their own perception. Overall, the survey results underscored the need for additional advancements in the cultivation of critical thinking abilities among Saudi students.

Tables 5, 6, 7, and 8 present insightful correlations between CT abilities, gender, GPA, and family background. In Table 5 in Appendix 1, a notable gender disparity emerges: Male and female students alike recognise the significance of Critical Thinking (CT) in the context of higher education, although their viewpoints differ marginally. Regardless of gender, students concur on the significance of CT. However, their approaches to it differ in subtle ways. Male students are more likely to associate CT with clearly defined objectives and perceive it as a substantial instrument for attaining said objectives. Female students, although acknowledging the importance of CT, generally possess a more comprehensive comprehension of its function within the realm of higher education. The aforementioned distinctions are inconsequential and do not undermine the consensus regarding the worth of CT in higher education. Interestingly, the male students excelled at comprehending complex relationships among variables. This gender-based differentiation underscores the role of gender in influencing how students approach CT and goal-setting. Additionally, GPA levels are linked to specific strengths and areas for improvement in CT skills, shedding light on the intricate interplay between these factors in academic performance and cognitive abilities.

Moving to Table 6 in Appendix 1, the connection between CT abilities and GPA becomes evident. Students with a GPA of 90–100 excelled at recognising inappropriate emotional language but need to prioritise CT in psychology. Conversely, students with a GPA of 70–80 outperformed their counterparts in the 80–90 and 90–100 categories. This finding highlights a nuanced understanding: even among high-achieving students, there is a targeted area for improvement–specifically, the application of CT skills within the realm of psychology. The observation underscores the complex nature of CT and its diverse relevance across academic domains.

Table 7
Model Summary

Model	*R*	*R* Square	Adjusted *R* Square	Std. Error of the Estimate
1	.542	.459	.416	7.77273

As seen in Table 7, a multiple linear regression model accounted for 40.16% of the variability in the students' CT skills. Gender and maternal education level were significant factors that influenced CT skills development. Females tended to exhibit higher proficiency in CT, while a positive correlation existed between maternal education level and CT skills development.

Table 8
Analysis of Variance

Model	Sum of squares	*df*	*M* square	*F*	*p*
Regression	1510.578	18	93.921	2.389	< .001
Residual	24286.987	402	60.415		
Total	25797.565	420			

Table 8 illuminates a noteworthy association between CT abilities and personal and familial background traits, with maternal education level emerging as a positive influence on CT skills development. The ANOVA analysis ($F = 2.389$, $p < .001$) underscores a significant correlation between students' development of CT skills and their personal and familial background. The multiple regression coefficients further reveal key insights: female students exhibit higher vertical thinking abilities ($B = 1.607$, $p = .047$), and those with GPAs of 90-100 surpassed their peers with GPAs of 80-90 and 70-80 in CT.

A significant positive relationship is established between maternal education levels and CT development. However, no significant relationships were identified between CT skills and paternal education levels, study specialisation, or parental employment levels. In sum, the study underscores the impact of specific background factors, notably maternal education, on students' CT abilities, offering valuable insights into the nuanced interplay between these variables.

Qualitative Results from the Interviews with the Teachers

The teachers proposed multiple definitions of CT skills and acknowledged that it is crucial for students to develop these skills so that they can successfully tackle challenges, engage in thorough research, and excel in their studies. For instance, one teacher defined CT as, "the ability to identify the problem, analyse issues and reasoning, and maintain neutrality in judging arguments – without bias." Similarly, a female teacher described CT, stating, "Critical thinking focuses on students' ability to solve problems and reach conclusions," highlighting the problem-solving aspect of CT.

The interviews revealed that effective CT development depends on active classroom participation and collaborative education programmes. Teachers are key in this process, as one male teacher emphasised the need for information literacy: "Students should rely on reliable sources, like academic sites, and distinguish between different information sources." Complementing this, a female teacher focused on student autonomy: "Students should not depend solely on teachers for developing critical skills. For example, we challenge them with problems not found in textbooks."

Integrating current pedagogical methods and building students' confidence in their viewpoints were identified as challenges. Bullying was cited as a significant barrier to independent thinking and CT development. Addressing this, one male teacher stated, "Teachers often don't motivate students to think critically, discouraging questions in class." A female teacher echoed this, expressing "While I try to encourage problem-solving, the focus on memorisation in the curriculum limits fostering critical thinking."

These insights from the interviews underscore the need for teachers to inspire CT and create a safe learning environment. Adapting teaching strategies to develop students' confidence and independent thinking is essential for their growth in CT skills.

Discussion

The current study explores the development of CT among upper-secondary students in Saudi Arabia, employing a mixed methods research design to gain insights from both students and teachers. A quantitative approach utilised an online questionnaire administered to a substantial sample of upper-secondary schools' students in Riyadh, Saudi Arabia. Concurrently, qualitative data was collected through interviews with teachers. Statistical analyses, including regression analyses using SPSS, were conducted on the quantitative data, while thematic analysis was employed to analyse the qualitative insights obtained from the interviews.

The study uncovered congruencies in the perspectives of both students and teachers concerning CT, emphasising problem-solving, analysis, and decision-making skills. Notably, the participating students demonstrated a broader conception of CT that encompassed creativity and deep thinking. This aligns with findings from Beverley (2016), where British students and teachers shared a consensus on the definition of CT. However, discrepancies were observed when compared to Knight (2007), who reported differences in the perceptions of skill assessment between students and teachers. It is essential to note that while Knight's study relied on practical assessment, our study derived insights from students' perceptions, accounting for the divergent results.

Regarding the students' CT proficiency, the findings suggested that they can engage in analytical thinking, but abilities vary. Moreover, many students appeared to lack confidence in their CT skills, although this did not appear to hinder their use of those skills in educational settings. However, at times, some students may hesitate to question their teachers or the content of their educational materials because they lack confidence in their ability to think critically. Therefore, educational practises should focus on developing CT skills and boosting students' confidence in their ability to think critically.

The findings also emphasised the need to improve students' comprehension of the significance of CT in psychology and its relevance in their daily lives. Without a clear understanding of the importance of CT, students may not feel motivated to develop and use these cognitive skills.

Saudi Arabia's cultural values, traditions and norms shape how students view CT. The existence of this cultural component could potentially impede the growth of CT and engender a deficiency in students' self-assurance regarding these capabilities. Certain cultural assumptions may hinder the development of CT skills. One way to enhance curricula is by incorporating CT exercises that showcase respect and cultural sensitivity. This approach allows students to recognise the importance and usefulness of CT skills in their own cultural contexts.

Researchers have identified a deficiency in CT skills among Saudi students, as evidenced by their performance in international assessments (Alharbi, 2022). For instance, recent TIMSS examination results revealed that eighth-grade Saudi students scored lower than their global counterparts in science and mathematics, subjects intricately linked to CT (Alharbi, 2022). Similarly, the 2018 PISA assessment indicated that Saudi Arabia's average math score was 374, compared to the global average of 489 (Alharbi, 2022).

Addressing this challenge requires a nuanced teaching approach. While cooperative learning activities, such as collaborative projects and idea exchanges, have shown promise in fostering CT skills (Alwadai, 2014), it is crucial to recognise the diversity of effective teaching methods. Limitations in CT skills may stem from outdated teaching practices and students' lack of confidence (Alwadai, 2014). Thus, educators need to adopt a variety of innovative approaches tailored to the specific needs of the students and the subject matter.

To enhance CT, educators must actively engage students in interactive learning experiences. Cooperative learning activities encourage independent thought but also facilitate a deeper understanding of complex topics through peer interaction (Alharbi, 2022). However, teachers must create an environment that instils confidence in students, fostering a collaborative and trusting atmosphere where questions are encouraged.

Innovative teaching methods are underscored by real-life events and verifiable information (Alharbi, 2022). Statistical data further support this argument, revealing that students taught through innovative methods are twice as likely to achieve better scores on standardised tests than those taught through traditional approaches. Moreover, these students demonstrated an increased inclination to pursue higher education and secure higher-paying jobs, emphasising the broader societal impact of effective teaching strategies (Alwadai, 2014). Nevertheless, it is crucial to approach these findings with caution, recognising that various factors contribute to academic outcomes. A holistic understanding of the challenges faced by students is essential for effective intervention.

The increasing adoption of inquiry-based learning in education is a positive trend, involving active student participation in research and subject evaluation. A study conducted by Alharthi and Alsufyani (2020) supported the benefits of inquiry-based learning, indicating that students exposed to this approach achieved higher scores in CT tests compared to peers who did not engage in such methods. This underscores the potential effectiveness of inquiry-based learning in fostering and enhancing CT abilities.

Furthermore, the integration of modern teaching methods aligns with global educational trends that prioritise problem-solving, collaboration, and hands-on learning. These approaches better prepare students for the challenges of the modern world, where CT is a crucial skill. Notably, the implementation of project-based learning has shown promising outcomes, leading to increased completion rates and improved project quality. Research, including a study by Alharthi and Alsufyani (2020), consistently indicates that project-based learning positively influences academic performance and enhances CT skills. Students exposed to these methods not only perform better academically but also acquire practical CT skills that are valuable for real-world applications.

In line with previous research, the present study found that female students exhibited better CT skills than male students. In addition, higher GPAs correlated with increased CT skill development increased, indicating that academic performance can motivate students to engage in CT.

Regarding barriers to the development of students' CT, Bean and Melzer's (2021) assertion that bullying limits learners' capacity to voice their opinions is in line with the interview findings of the present study. Addressing bullying is crucial for students' self-expression and confidence. Meanwhile, according to UNESCO, it is imperative to address bullying for the enhancement of students' self-expression and confidence (UNESCO, 2019). In addition, several educators opt to integrate CT across various courses instead of treating it as a standalone subject (O'Higgins, 2020). Furthermore, educators in Saudi Arabia express apprehension regarding the inability of their peers to cultivate CT abilities in students as a result of the profoundly entrenched culture of indoctrination prevalent in the country. Additionally, as per the interviewees, this culture of indoctrination had an adverse effect on the self-esteem of certain students and impeded their capacity to engage actively in classroom discussions. The multiple regression analysis also revealed a statistically significant correlation between maternal education level and students' CT skills. Furthermore, in relation to the influence of parental education on CT, the interviewees disclosed that the impact of maternal education was more pronounced than that of paternal education for CT capabilities. Indeed, the cultivation of CT remained unaffected by paternal education. One reason for this result may be that the majority of Saudi women remain at home to care for their children (Human Rights Watch, 2017) and thus have a greater degree of authority than men regarding their children's academic progress. In addition, research has found that unemployed female graduates who remain at home have a positive impact on students' capacity to develop CT abilities. According to Leibbrandt and List

(2015), male graduates in the USA have an unemployment rate of 7.5%, while the rate among female graduates was 33.5%.

The qualitative and quantitative findings of the current study indicated that a lack of motivation among teachers and students hinders the development of CT skills. To address this issue, teachers should receive specialised training and cultural changes should be made to promote CT among students. This is in line with Allamnakhrah's (2013) findings regarding the need for teacher training and cultural changes to promote CT skills among students. That study highlighted the importance of family environments and cultural changes in fostering CT. Teachers suggested different methods to promote CT, such as problem-solving projects, written compositions, classroom discussions on social issues, and others.

In the past, the Saudi education system emphasised memorisation rather than nurturing CT abilities. It is widely acknowledged that traditional memorisation techniques are insufficient to prepare students for the demands of a rapidly evolving society and economy (Perkins et al., 2018). There has been a shift in focus in the Saudi education system because policymakers are realising the significance of CT skills in a connected global society. Regarding real-world examples, occupations in such fields as engineering and healthcare require the ability to analyse complex data and make informed judgements, making CT skills essential.

This study's findings suggested that Saudi Arabia has made improvements to its educational plan by incorporating CT skills, including analytical thinking and problem-solving skills. The National Transformation Program (NTP) 2020 and Vision 2030 showcase the government's dedication to education sector reform. For example, the Vision 2030 educational initiative, led by the Ministry of Education, aims to promote CT skills among students. Furthermore, the Ministry of Education has set aside funds for teacher training courses that focus on integrating CT into educational methods. The interview data indicated that an increasing number of educators are participating in professional development programmes that emphasise CT pedagogy.

The introduction of a CT module into the formal education system by the Saudi Ministry of Education in 2020 marked a pivotal turning point in educational policy (Al-Otaibi, 2020). This strategic move, aimed at developing Saudi students' CT skills, aligns with a broader shift in educational priorities within the country (Almulla, 2018). Recognising the significance of CT for personal growth and socioeconomic progress, this initiative reflects a proactive approach to preparing students for the challenges of a rapidly evolving global landscape (Bawazeer, 2020).

The inclusion of CT in the formal education system also underscores Saudi Arabia's commitment to benchmarking its educational outcomes on the global stage. This is evidenced by its participation in assessments like the Programme for International Student Assessment (PISA). The acknowledgement of the importance of nurturing CT abilities is not only a national policy objective but also an indication of Saudi Arabia's commitment to international standards of education and competitiveness (Alatawi, 2022).

Alatawi's (2022) findings highlighted the significance of this initiative, emphasising the importance of statistical data in assessing the impact of integrating CT into the education system. This forward-looking policy is likely to contribute not only to individual student development but also to Saudi society's overall advancement, aligning with contemporary educational paradigms that prioritise CT as an essential skill for success in the 21st century.

Conclusions and Implications

The present study has revealed key points that can be organised into six categories. First, it is crucial to integrate CT into the comprehensive national curriculums for secondary and tertiary education. The curriculum should have modules for problem-solving, analytical thinking, and decision-making skills with well-defined learning objectives and assessment criteria. Establishing precise rules and guidelines is essential for maintaining uniformity in the education of CT across educational institutions.

Second, a plan for teacher training in CT must be put into action. The training programme should have a structured framework and cover various teaching methods for developing CT in the classroom. Workshops, seminars, and professional development are also important ways for teachers to learn how to foster CT.

Third, active parental involvement is essential for fostering CT skills. Parents should be involved in the learning process that emphasises students' participation in activities requiring CT, according to the findings of this study. In order to accomplish this objective, the government may initiate an awareness campaign that underscores the significance of involving children in extracurricular educational pursuits; this may inspire parents to assume more accountability.

Fourth, government initiatives for extracurricular learning should be established. A public awareness campaign on the importance of extracurricular activities and parental involvement should be launched. This comprehensive campaign should not only highlight the benefits of extracurricular activities but also offer resources for parents and encourage educational institutions to diversify their extracurricular offerings.

Fifth, teacher-student interactions should be enhanced. To that end, a teaching strategy model should be designed and implemented to improve interactions between teachers and students. In addition, a software app should be created to enhance communication, feedback and mentoring between teachers and students. To ensure the successful implementation of a programme or initiative, practical exercises and coaching methods must be incorporated.

Sixth, to address gender stereotypes and inequalities, it is crucial to support the development of female students’ CT skills beyond upper-secondary school. Initiatives that aim to improve women’s CT skills, support their success in academic settings, and promote their overall personal development should be proposed by individuals involved in the design, implementation, and evaluation of CT programmes. Moreover, these stakeholders, including educators, policymakers, researchers, and other interested parties, should actively advocate for gender equality in CT programmes to tackle existing disparities.

Declaration of Interest

The authors declare no competing interest.

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Appendices

Appendix 1: Results tables

Table 5

Relationship between Critical Thinking Items and Gender

No.	Item	Male	Female	Whitney Mann	*p*
1	I can detect the use of inappropriate emotional language in scientific arguments * GPA Category	216.2	220.0	-.360	.719
2	I have a well-defined goal in mind when I am critical	239.1	211.4	-2.576	.045
3	I can identify the structure of arguments without being distracted by their content	222.7	218.7	-.341	.733
4	Critically thinking is particularly important in psychology	234.1	202.3	-2.692	.007
5	Critical thinking is essential in higher learning and education	209.7	224.3	-1.99	.049
6	When there is a very strong relationship between two variables, we can claim that one causes the other	244.1	192.9	-4.29	< .001
7	Critical thinking develops as you progress through your degree	219.1	223.5	-.391	.696
8	I can express my critical thinking well in my written work	223.3	216.9	-.560	.575
9	You cannot get a good degree without good critical thinking skills	208.4	230.0	-2.01	.045
10	I prefer to do things where there is a quick answer	217.6	220.8	-.281	.779
11	I have a focused and systematic way of thinking	216.8	225.3	-.803	.422
12	All relevant information should be presented in session slides	210.7	233.3	-2.194	.042
13	Generally, I am a good critical thinker	212.4	227.5	-1.93	.048
14	I do well in assessments that ask for critical evaluation	200.4	240.1	-3.48	< .001
15	I think critically while working on my assignments (homework)	216.8	235.5	-1.89	.049
16	All my teachers and peers expect me to think critically	213.0	203.0	-2.00	.045
17	I can use more than one method to deal with complex problems	228.0	223.4	-.877	.380
18	I can get high marks in exams if I can think critically	221.0	211.8	-.793	.428
19	I have the ability to judge the value of new information or evidence presented to me	208.2	228.4	-2.084	.044
20	I can evaluate the arguments of others well	204.0	231.4	-2.472	.013
21	Critical thinking is when you describe what is wrong with something	210.9	220.2	-.822	.411

22	I can say: I am good at looking at the positive and negative sides of things.	211.2	226.8	-.14	.153
23	I think critically while reading	208.7	221.9	-1.14	.253
24	I can rephrase the arguments of others in my own words easily	206.7	232.6	-2.59	.018
25	I think critically in class	198.3	240.0	-3.71	< .001

Table 6

Relationship between Critical Thinking Items and GPA

No.	**Item**	**Mean rank**			χ^2	***p***
		70-80	**80-90**	**90-100**		
1	I can detect the use of inappropriate emotional language in scientific arguments * GPA Category	201.2	209.6	229.1	5.49	.036
2	I have a well-defined goal in mind when I am critical	2.33.1	218.6	220.0	.682	.711
3	I can identify the structure of arguments without being distracted by their content	245.8	217.4	217.0	2.99	.223
4	Critically thinking is particularly important in psychology	225.8	260.5	203.0	17.8	< .001
5	Critical thinking is essential in higher learning and education	189.3	225.5	218.9	4.0	.134
6	When there is a very strong relationship between two variables, we can claim that one causes the other	215.3	251.2	211.8	8.24	.016
7	Critical thinking develops as you progress through your degree	218.4	212.9	229.9	1.01	.433
8	I can express my critical thinking well in my written work	238.3	221.7	216.6	1.01	.604
9	You cannot get a good degree without good critical thinking skills	222.7	208.3	224.4	1.48	.477
10	I prefer to do things where there is a quick answer	206.3	209.2	227.1	2.63	.269
11	I have a focused and systematic way of thinking	211.3	230.2	219.4	1.32	.516
12	All relevant information should be presented in session slides	223.9	238.9	212.7	3.76	.153
13	Generally, I am a good critical thinker	212.7	209.5	222.7	1.05	.591
14	I do well in assessments that ask for critical evaluation	212.7	201.5	226.0	3..48	.176
15	I think critically while working on my assignments (homework)	252.7	231.4	216.4	5.69	.039
16	All my teachers and peers expect me to think critically	247.6	216.7	212.4	4.44	.109
17	I can use more than one method to deal with complex problems	236.0	188.0	228.4	10.56	.005
18	I can get high marks in exams if I can think critically	225.1	218.3	228.4	.330	.848
19	I have the ability to judge the value of new information or evidence presented to me	208.0	236.8	211.8	6.11	.038
20	I can evaluate the arguments of others well	229.1	212.7	219.3	.886	.642
21	Critical thinking is when you describe what is wrong with something	224.1	214.6	213.9	.393	.822
22	I can say: I am good at looking at the positive and negative sides of things	235.5	223.5	212.4	2.356	.308
23	I think critically while reading	225.0	204.7	217.0	1.33	.514

24	I can rephrase the arguments of others in my own words easily	227.9	191.8	245.4	10.69	< .001
25	I think critically in class	204.3	216.1	220.4	.955	.620

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THE INFLUENCE OF TEACHING COMPETENCIES ON TEACHERS' PERFORMANCE AND STUDENTS' ACADEMIC ACHIEVEMENT IN PRIMARY SCIENCE EDUCATION

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Abstract

The teaching competencies of science teachers significantly influence students' science academic achievement. It shapes the students' understanding of complex science concepts and their ability to excel in scientific exploration, ultimately nurturing their scientific literacy. This study assessed the teaching competencies influencing the teaching performance of 58 primary science teachers relative to the academic achievement of their students in science at the Tinoc District, Tinoc, Ifugao, Philippines. The significant differences by teacher demographics were also determined. This is relevant to the district's observed low scientific literacy and achievement of students in science education as assessed in recent years. Using a quantitative approach, the study employed a modified questionnaire that was validated and pilot-tested. Results disclosed that the science teachers strongly agreed that professionalism is the most common teaching competence influencing their performance, indicating their adherence to local and national standards and code of conduct. They also strongly agreed with teaching effectiveness, personal skills, educational planning, and management skills. Generally, there were no significant differences among the teaching competencies regardless of the teachers' gender, age, highest educational attainment, and years in service. Meanwhile, the students' science academic achievement was determined to be lower average, suggesting low scientific literacy. Correspondingly, the teaching competencies and students' academic achievement were not correlated. Nonetheless, the teacher's capacity to impact the learners' scientific exploration and achievement remains intact. Further studies are recommended to be undertaken.

Keywords: *primary science education, primary science teachers, students' science academic achievement, teaching competency, teacher performance*

Introduction

Education greatly impacts nationwide development where teachers play a central role, involving acquiring students' knowledge and skills and securing the nation's future. The role of teachers is paramount, serving as the cornerstone of educational and societal development. Beyond the transmission of knowledge, teachers play a pivotal role in shaping students' character, values, attitudes, and behaviors. The public recognizes not only the teachers' responsibilities but also their roles in society (Jan, 2017; Keiler, 2018; Siddiqui & Ahamed, 2020). Their influence extends beyond the classroom, contributing to forming responsible, informed, and morally grounded members of society.

The role of a teacher is essential in facilitating knowledge transfer and technical skills between generations, contributing to the preservation and advancement of the nation's perspective. They serve as the nation's builders and as a source of information and principles for

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young individuals. Teachers uphold cultural values and pass these on to subsequent generations (Siddiqui & Ahamed, 2020). They are widely regarded as the primary stakeholders within the educational system, given that their performance is vital in shaping the academe (Abdallah & Alkaabi, 2023). They convey worthwhile changes to students (Rajagopalan, 2019). Thus, better education plays a significant role in achieving students' success.

The role and quality of teachers are mostly evaluated through their performances. Teacher performance is an observable set of attitudes and behaviors that lead to students' acquisition of knowledge and skills (Martin, 2018). There is a more favorable evaluation of the teachers' performance as the students gain more knowledge. As teachers continue their professional development, their teaching effectiveness, quality, and performance are enhanced. Teachers with better teaching performance can be characterized by their ability to implement pedagogical practices suitable for students' developmental stages and based on a deep understanding of the subject matter. They can establish learning environments conducive to learning by ensuring safety, security, equity, and support, fostering student accountability and success. They can create educational environments that are attuned to students' diversity. Teaching performance also embodies the teacher's ability to implement diverse assessment tools and methodologies to oversee, record, and communicate students' requirements, advancement, and accomplishments. They recognize and diligently carry out their responsibilities to maintain professional integrity and openness, fostering professional and harmonious relationships with students, parents, stakeholders, and the community (Department of Education, 2017; Martin, 2018).

Teaching is a complex endeavor involving a series of planned activities to facilitate predetermined students' learning outcomes. In this teacher's endeavor, competencies encompass a broad range of abilities extending beyond their subject matter expertise. Teaching competency pertains to the knowledge, skills, values, attitudes, and behaviors possessed by a teacher to improve their performance or qualifications. Competency is crucial to teachers' aim of excellence (Nessipbayeva, 2012). It can include pedagogical expertise, academic credentials, motivation, experiences, interests, professional development, and aptitude. Though related to teacher performance, teaching competency embodies a teacher's underlying knowledge, skills, and abilities. Teacher performance is directly observed in the actual teaching process, while teaching competency is the qualifications that a teacher brings to their educational role (Department of Education, 2017; Martin, 2018; Nessipbayeva, 2012).

Teachers integrate their expertise, proficiency, and capabilities to form distinct performance skills that drive students' knowledge acquisition and accomplishments. Since competency is measurable, various variables can be used to evaluate teachers' competencies. It can include assessment capabilities, developing classroom and educational plans, classroom maintenance and safety, student behavior management, relationships with students, collaborating with colleagues and superiors, implementing and adhering to policies, and curriculum management (Nessipbayeva, 2012), among others. These variables directly influence students' achievement, as the primary objective of teaching is to facilitate the holistic development of students (Javed et al., 2020).

Teaching competency in science education is significant as it ensures the accurate and effective transmission of complex scientific concepts and fosters students' critical thinking, inquiry skills, and passion for scientific inquiry. Science education is often characterized by its abstract and complex nature. Consequently, the effective teaching of science requires particular attention on the part of the teachers. It is imperative to optimize student involvement and promote the understanding of scientific principles through tangible and straightforward education (Bal-Taştan et al., 2018). It is asserted that teachers matter and that their attributes have a crucial role in shaping the motivation to learn among science students (Bietenbeck, 2011). Teachers play a significant role in influencing student progress in all areas of science education within the school setting (Rockstroh, 2013).

Primary education is widely recognized as the foundational stage in the educational journey (Wechsler et al., 2016). The inclusion of science education in primary schools has been found to enhance students' decision-making skills development. The acknowledgement that science is everywhere and can be interconnected with any aspect of the natural world is present (Fitzgerald & Smith, 2016). Emerging research highlights the significance of directing attention toward the primary school years as a fundamental basis for subsequent achievements in the field of science. This level is crucial in acquiring scientific information and abilities. Additionally, this level serves as a significant point where disparities in academic achievement begin to emerge among the students (Jimenez & Menendez Alvarez-Hevia, 2021; Morgan et al., 2015).

Research Significance

Examining the teaching competencies of primary science teachers holds significance for teaching effectiveness and student outcomes. By comprehensively examining the teaching competencies, such as personal skills, management skills, educational planning, teaching effectiveness, and professionalism, and their influence on teaching performance and students' achievement can provide valuable insights among global researchers and educational institutions into the factors influencing the quality of science education at the primary level. A deeper understanding of teaching competencies in primary science education is crucial for shaping informed pedagogical approaches that can empower teachers to create engaging and effective learning experiences, laying a solid foundation for students' lifelong learning and future academic success. This research may be a valuable reference for other scholars investigating teaching competencies. The researchers hope this study contributes to enhancing teacher training programs, curriculum development, and educational practices, ultimately fostering an environment that nurtures students' scientific literacy and critical thinking skills.

Teaching Competencies

Personal Skills. The teaching profession is considered noble, encompassing both science and art. The teacher can enhance the teaching experience by enjoying and demonstrating a commitment to carrying out their professional responsibilities. The attainment of productive outcomes can be achieved by adopting a perspective that views the role of the teachers not solely as a giver of knowledge but also as an individual who demonstrates concern for students' needs and behaviors (Maazouzi, 2019). Hughes and Chen (2011) posited that students who establish a stronger emotional connection with their teachers tend to develop more favorable relationships with their peers. This positive relationship is associated with enhanced academic self-efficacy when students reach higher grades. Skaalvik and Skaalvik (2013) determined a favorable correlation between teacher-affective behaviors and students' intrinsic drive and academic self-concept.

Management skills. The most effective teachers can optimize students' educational capabilities. According to Maazouzi (2019), fostering academic achievement can be accomplished by establishing a pleasant, respectful, and robust management of students. An ideal classroom environment conducive to learning is characterized by a climate that embraces accepting mistakes which are integral to the learning process (Hattie, 2008). Teachers must manage an environment that fosters the acceptance and acknowledgment of mistakes. Further, the educational environment is characterized by a classroom that promotes active learning engagement and enthusiasm, with both teachers and students actively participating (Hattie, 2008). Teachers must possess expertise in various domains for effective learning, such as providing constructive criticism and praise, managing mistakes, addressing inquiries, and delivering well-organized lessons. Teachers must emphasize several aspects as well, such as anxiety reduction, motivation enhancement, incorporation of humor, and allocation of sufficient time for learning (Sieberer-Nagler, 2015).

Educational planning. This facilitates the teachers' comprehensive and reasonable introduction of subjects and the attainment of educational aims (Hofer & Harris, 2019). Instead of learning new information through reading, observing a demonstration, or attending a lecture, teachers should plan and create lessons that encourage students to learn new information through inquiry. Teachers should allow students to examine, discuss, and challenge ideas with their peers during a lesson (Ozfidan et al., 2017). In a conducive environment, students possess the capacity and liberty to pursue self-improvement and can exercise agency over their learning trajectory. Consequently, teachers should invest effort in ensuring that their students acquire the most knowledge possible and develop a genuine interest in them. By doing so, they provide quality education so long as the student remains at the core of their teaching.

Teaching effectiveness. Muijs and Reynolds (2011) discussed that developing students' critical thinking is vital whenever possible by posing higher-level questions. They hold questioning to be a crucial component of effective teaching and should be allocated a significant amount of time. Inquiries that probe for more advanced concepts, like requiring students to devise an experiment in science, are advocated. This is because questions at the higher level require students to comprehend the lesson better. Students must understand the science processes and abilities to be acquired, and they should be provided with guidance through exploration questions. Rauf et al. (2013) implied that teachers should consistently provide guidelines throughout experiments or lessons to ensure students recognize their acquisition of science process skills. Since science demands great passion from teachers (Lebata, 2014), they must allocate sufficient time to facilitate the comprehension of scientific concepts, sometimes perceived as intricate, uninteresting, and inconsequential by students. They have to make the subject engaging.

Professionalism. It is critical to acknowledge that the responsibilities of a teacher extend beyond the act of teaching itself (Nurhayati, 2018). This includes planning, implementing, and assessing educational activities. Teachers are responsible for fostering professional advancement, enhancing their pedagogical abilities, acquiring proficiency in contemporary educational approaches that align with current educational demands, and cultivating expertise in information and communication technology (ICT). It is significant to devise the elements and standards of teachers' professional development to facilitate their comprehension of the diverse needs of students in social, emotional, and educational domains, as well as to demonstrate the teachers' competencies across knowledge, skills, and attitudes (Darling-Hammond et al., 2017). The teachers' professional development is widely recognized as a means to augment their knowledge and expertise in various subject areas. It catalyzes behavioral change among teachers and facilitates their attainment of a higher level of professional growth. Consequently, when schools offer opportunities for learning, knowledge acquisition, and skill development, teachers' performance is expected to improve (Darling-Hammond et al., 2017).

Teacher Characteristics and Competencies

In Wood's (2012) survey of primary school teachers, the differentiation between female and male teachers remains ambiguous. The survey results indicated no statistically significant disparities in the perceptions of females and males. However, qualitative distinctions were observed, as male teachers received more negative comments than their female counterparts regarding their ability to nurture students effectively. Likewise, Islahi and Nasreen (2013) indicated no statistically significant disparity in teaching styles between male and female teachers. Lim and Meer (2017) indicated that female students tend to achieve higher examination scores when female teachers teach them. However, they revealed a limited impact of same-gender teachers on the academic achievement of male students. They proposed that the observed student accomplishment can be attributed to teacher behavior.

Sivasakthi Rafammal and Muthumanickam (2012) determined no discernible disparity in teachers' effectiveness between those younger, namely those at 30 years old and below, and those who are more mature or middle-aged, specifically between 30 and 40 years old. It suggested that age, irrespective of whether teachers are young, mature, or older, does not have a discernible impact on teacher effectiveness. Chiang and Wang (2014) showed that teachers above the age of 30 exhibited a greater inclination toward autonomous decision-making in the field of education as compared to other age groups. Waseka et al. (2016) yielded that teacher's age does not possess much predictive power concerning a student's academic achievement.

Ronfeldt et al. (2013) and Klassen and Tze (2014) determined that there is limited knowledge regarding the impact of graduate education on teachers' professional status, which can indirectly affect student outcomes. Sahlberg (2015) posited that implementing a master's degree prerequisite has effectively enhanced the appeal of the teaching profession, attracting individuals who possess exceptional talent and motivation. This elevation in the teaching profession has resulted in expanded opportunities beyond traditional classroom settings, including pursuing doctoral studies (Horn & Jang, 2017). On the contrary, Tucker and Fushell (2013) and Kowalczuk-Waledziak et al. (2017) demonstrated that pursuing a postgraduate master's degree has a beneficial influence on teachers' perceptions of themselves as professionals.

Unal and Unal (2012) noted a significant association between teachers' experience and their attitudes towards classroom management. Experienced teachers exhibited distinct attitudes characterized by a higher level of classroom control, effective interaction with students, and enhanced decision-making abilities compared to their less experienced counterparts. Sadik and Akbulut (2015) asserted that teachers with a minimum of ten years of teaching experience exhibit heightened effectiveness and proficient managerial abilities.

Teacher Competencies and Students' Academic Achievement

The teachers' competencies influence students' academic achievement and level of engagement in science. This includes the teachers' effectiveness of the teaching design and materials, confidence, and pedagogical abilities (Moeini et al., 2018). Undoubtedly, students' accomplishments can be attributed to the efforts of their teachers. The South African Council for Educators (SACE) report in 2010 found evidence of an association between the level of content knowledge possessed by teachers and students' academic achievement. According to Gitaari et al. (2013) and SACE (2010), it is generally acknowledged that teachers have a pivotal position in successfully implementing the curriculum. In order to effectively deliver the program, teachers must possess a high level of training and expertise. The significance of the role of teachers in determining the quality of education is underscored by Spaull (2013), who asserted that the quality of teachers inherently limits the quality of education. Studies have indicated that students who were instructed by teachers lacking proper qualifications or trained teachers who require assistance in comprehending the subject matter of science tend to get unsatisfactory outcomes (Lebata, 2014).

Empirical evidence suggests that teachers who cannot employ an appropriate pedagogical approach and exhibit a suitable demeanor during teaching contribute to students developing unfavorable perceptions of the field of science (Abudu & Gbadamosi, 2014). Consequently, this phenomenon is associated with students' subpar academic achievement. Quality science teachers possess specialized knowledge in science, demonstrating a comprehensive understanding of scientific concepts that extend beyond the prescribed curriculum. They employ diverse teaching strategies to effectively teach science, exhibiting enthusiasm and confidence in their approach.

Furthermore, quality science teachers dedicate additional time beyond their professional obligations to ensure that students grasp the fundamental principles of science (Tsanwani et al., 2014). Understanding the application of educational procedures of science, teachers play a crucial role in fostering the interests and attitudes of students toward pursuing science subjects in the future. These procedures include assessment methods, organizing students into groups, and using rewards. Measuring teachers' performance is widely conducted by assessing students' academic accomplishments globally, where most assessments employ written examinations (Shah et al., 2011).

Primary Science Education in the Philippines

The primary objective of science education in the Philippines is to cultivate scientific literacy among students, equipping them with the necessary knowledge and skills to become engaged and knowledgeable individuals able to make well-informed judgments and decisions regarding the practical implementation of scientific knowledge, particularly those with potential social, health, or environmental impacts (Department of Education, 2016). The Kindergarten to Grade 12 (K to 12) Science curriculum modified by the Department of Education (DepEd) adopts a student-centered approach that prioritizes inquiry-based and evidence-based learning to develop explanations. The curriculum incorporates a spiral progression approach, wherein the concepts and skills in Biology, Physics, Chemistry, and Earth Sciences are systematically introduced and developed across different grade levels. It allows for an incremental increase in complexity, enabling students to cultivate a more profound comprehension of fundamental principles within these disciplines. Based on DepEd, one way to evaluate students' academic achievement is through the Mean Percentage Score (MPS). It is the students' raw score, denoting the proportion of accurately answered items in an examination relative to the overall number of items. For instance, if a student obtains an MPS of 50% in a subject, they have accurately responded to 20 out of the 40 test items.

The Philippines participated in the Programme for International Student Assessment (PISA) administered by the Organization for Economic Co-operation and Development (OECD). For PISA 2022, Filipino students performed way below the OECD average in science. This is a similar result when the country participated in PISA 2018 (OECD, 2023). Only 23% of the students attained a basic proficiency in science. This indicates that only one out of four students can discern the accurate rationale behind well-known scientific occurrences and validate conclusions (Chi, 2023; OECD, 2023). This result underscores the pressing need to address the existing concerns and disparities in achieving a high standard of basic education in the Philippines. This suggests a need for a more comprehensive understanding of the content of the K to 12 curriculum standards (Hernando-Malipot, 2023).

Research Gap

The acknowledgment that teaching competencies influence students' development of scientific literacy to empower them to engage in a thoughtful and informed manner makes the teachers' role an essential aspect of science education (Bal-Taştan et al., 2018; Bietenbeck, 2011; Rockstroh, 2013). Effective science teachers are crucial in fostering a scientifically literate individual, which, in turn, benefits society by enabling informed decision-making, critical thinking, and active engagement with scientific issues. However, below-average achievement of students in science, especially in the country, is observed, as implied by international achievement tests (Chi, 2023; OECD, 2023). This issue has prompted the study to examine and evaluate the competencies that influence the teaching performance in association with the academic achievement of students in science in the locality.

Research Aim and Research Questions

This study aimed to assess the teaching competencies influencing science teachers' performance and their association with the academic achievement of their students in primary science education. The study further aimed to explore the significant differences in the teaching competencies influencing the teachers' performance based on demographics. The following research questions guided the conduct of this study:

1. What are the teaching competencies influencing the teaching performance of primary science teachers?
2. Are there significant differences in the teaching competencies of the teachers when grouped according to their profiles?
3. What is the academic achievement of primary students in science?
4. Is there a correlation between the teaching competencies and students' academic achievement in science?

Research Methodology

General Background

A quantitative approach was used to assess the teaching competencies influencing the science teachers' performance and students' academic achievement. This approach is distinguished by its systematic and uniform approaches to gathering data, enabling the quantification of particular variables and the implementation of statistical methods for analysis (Creswell, 2009). The study specifically used a descriptive survey that allowed the determination of the teachers' perceived level of influence of the teaching competencies. It is a research technique in which information is gathered from the respondents through a questionnaire (Aggarwal & Ranganathan, 2019). The study was conducted during the last quarter of 2023.

Sample

The study was conducted at Tinoc District, Division of Ifugao, Philippines. There were 58 primary science teachers who participated. The selection process utilized total enumeration, involving all the teachers handling science subjects from Grades 3 to 6 levels from the 16 primary schools in the district. Even though all the science teachers were involved, the small number of participants reflects the districts' small numbers of schools, low student population, and few grade level sections. Based on the Philippine K to 12 Science Curriculum, the teaching of science as an independent and formal subject starts at the Grade 3 level. There is no stand-alone science subject for Grades 1 and 2. The science teacher participants were also selected for the purpose of evaluating the teaching competencies influencing their performance and their students' academic achievement in the locality, as structured in this study. Table 1 shows the demographic profiles of the teachers. Regarding gender, the sample population comprises 36% males and 64% female teachers. Based on age, 19% were 20 to 30, 45% were 31 to 40, and 36% were 41 to 50 years old. Regarding the highest educational attainment, 71% of the teachers have finished their bachelor's degree, while 29% have undertaken their master's degree. There were no involved teachers with doctorate degrees among the participants. Based on the years in service, 60% have 1 to 10, 33% have 11 to 20, and 7% have 21 to 30 years of experience.

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Table 1
Demographic Profiles of the Primary Science Teachers

Profiles	*N*	%
1. Gender		
a. Male	21	36
b. Female	37	64
2. Age		
a. 20 - 30 years old	11	19
b. 31 - 40 years old	26	45
c. 41 - 50 years old	21	36
3. Highest Educational Attainment		
a. Bachelor's degree	41	71
b. Master's degree	17	29
4. Number of Years in Service		
a. 1 - 10 years	35	60
b. 11 - 20 years	19	33
c. 21 - 30 years	4	7

As shown in Table 2, there were 284 students involved in the study across the Grades 3 to 6 levels. They were the primary students taught by the science teachers during the study's conduct. The data regarding science MPS of these students was the basis of the academic achievement used in correlational analysis with the teaching competencies. The student population comprised 19% from Grade 3, 25% from Grade 4, and 28% for Grades 5 and 6.

Table 2
Primary Students across Grade Levels

Students	*N*	%
Grade 3	55	19
Grade 4	71	25
Grade 5	79	28
Grade 6	79	28

Instrument

The study used a modified questionnaire based on the Philippine Professional Standards for Teachers (PPST) developed by the Department of Education (2017). This set of standards outlines the requisite information, skills, and principles teachers should possess to achieve proficiency, improve student learning outcomes, and ultimately deliver high-quality education. Some survey item statements were also based on the Winchester Public Schools Teacher Performance Evaluation System (TPES) constructed by Dr. James Stronge. It is utilized to gather and display data to determine teachers' performance assessed according to well-stated job requirements (Stronge, 2012). Using the PPST and TPES, the study developed 36-item statements that were categorized into five teaching competencies. These are personal skills, management skills, educational planning, teaching effectiveness, and professionalism. The survey questionnaire was validated by three school heads: two school principals and one department head. The validation indicated that all the items were valid, with an overall Aiken's validity coefficient of .856. Furthermore, pilot testing involving 20 teachers from a different district determined that the item statements have excellent reliability with an overall Cronbach's alpha of .959. The questionnaire was divided into two distinct sections. The first section required the teachers' profile regarding their gender, age, highest educational attainment, and years in service. The second part consisted of 36-item statements regarding the teaching competencies. A 4-point Likert scale was used to denote the influence of the teaching competencies, specifying that 4 = Strongly Agree (SA), 3 = Agree (A), 2 = Disagree (D), and 1 = Strongly Disagree (SD). On the other hand, students' academic achievement in science was determined by collecting the MPS data from their respective class advisers.

Procedures

The study was proposed to the researchers' affiliated institution for approval, outlining the study's objectives, methodology, and significance. The study's proposal was also submitted and sought approval from the institution's research ethics committee. A permission request letter was sent to the DepEd Ifugao Schools Division Office to conduct the study within the Tinoc District. It included permission requests for validation from school heads, pilot testing of the questionnaire, and gathering of the students' MPS. Upon approval, the questionnaire's validation was succeeded by pilot testing. Meanwhile, a consent letter was given to the selected teachers. It informed the study's overview, aim, and duration and commitment of their participation. The possibility of experiencing distress or emotional discomfort as a potential risk while answering the survey was presented, highlighting their right to withdraw from the study without facing any negative consequences. The letter also presented the probable conduct of relevant teacher training as a benefit of the study. The teachers' voluntary participation and confidentiality of their data were emphasized. The researchers' contact information was included for direct communication if concerns occurred during the study. Once the questionnaire was finalized, the researchers personally administered the survey to the science teachers. It was to answer queries from the teachers about the study and to ensure a higher retrieval rate of the questionnaires. The MPS of students were also personally gathered by the researchers. All data gathered were compiled in a spreadsheet and kept by the researchers. The treated and tabulated data from the teacher and students were treated with utmost confidentiality. Tabulation, analysis, and presentation of the results concluded the procedure.

Data Analysis

Descriptive and inferential statistics were used to organize and analyze the responses obtained from the teachers and students' academic performance. Frequency, percentage, and mean were used to analyze the teachers' responses. Statistical limits served to describe the results of the means, with 3.26 - 4.00 = Strongly Agree (SA), 2.51 - 3.25 = Agree (A), 1.76 - 2.50 = Disagree (D), and 1.00 - 1.75 = Strongly Disagree (SD). Likewise, the computed mean of students' academic achievement was described using the MPS quartile distribution. It describes the academic achievement as 76% - 100% = Superior, 51% - 75% = Upper Average, 26% - 50% = Lower Average, and 0% - 25% = Poor. The t-test was employed to assess whether a significant difference exists in the level of effect of the teaching competencies when categorized by gender and highest degree of education. Analysis of Variance (ANOVA) was utilized to compare significant differences in the teachers' profiles regarding age and years of service. The Pearson-product-moment correlation (PPMC) was used to examine the correlation between teaching competencies and students' academic achievement in science.

Research Results

As shown in Table 3, professionalism is the top teaching competency influencing the teaching performance of primary science teachers. It was followed by teaching effectiveness, personal skills, educational planning, and management skills. Results also showed that regardless of rank, all teaching competencies perceived strong agreement from the teachers.

Table 3
Teaching Competencies Influencing the Science Teachers' Performance

Teaching Competencies	*M*	*SD*	Descriptive Equivalent	Rank
A. Personal Skills	3.69	0.47	Strongly Agree	3
B. Management Skills	3.66	0.50	Strongly Agree	5
C. Educational Planning	3.68	0.47	Strongly Agree	4
D. Teaching Effectiveness	3.71	0.48	Strongly Agree	2
E. Professionalism	3.81	0.39	Strongly Agree	1

In Table 4, results indicate no significant differences regarding the personal skills, management skills, and educational planning competencies influencing the teacher's performance when grouped according to gender. There are also no significant differences in the perceived level of effect of teaching effectiveness and professionalism among the female and male teachers.

Table 4
Teaching Competencies Influencing the Teachers' Performance According to Gender

Teaching Competencies	Male		Female		*t*-value	*p*-value
	M	*SD*	*M*	*SD*		
A. Personal Skills	3.67	0.50	3.71	0.46	-0.949^{ns}	.189
B. Management Skills	3.65	0.51	3.67	0.49	-0.314^{ns}	.380
C. Educational Planning	3.75	0.44	3.64	0.49	0.670^{ns}	.078
D. Teaching Effectiveness	3.72	0.49	3.71	0.47	0.233^{ns}	.408
E. Professionalism	3.75	0.43	3.84	0.37	-1.844^{ns}	.053

Note: * = significant ($p < .05$); ns = not significant ($p > .05$)

Table 5 reflects that when the teachers were grouped according to age, there is a significant difference in the perceived level of effect of personal skills on the teaching performance of the teachers. However, there are no significant differences in the management skills and educational planning competencies. There are also no significant differences regarding teaching effectiveness and professionalism across the teachers' ages.

Table 5
Teaching Competencies Influencing the Teachers' Performance According to Age

Teaching Competencies	20-30 y/o		31-40 y/o		41-50 y/o		*f*-value	*p*-value
	M	*SD*	*M*	*SD*	*M*	*SD*		
A. Personal Skills	3.66	0.48	3.69	0.48	3.71	0.45	3.214*	.043
B. Management Skills	3.74	0.44	3.62	0.51	3.68	0.50	0.067^{ns}	.985
C. Educational Planning	3.82	0.39	3.69	0.47	3.60	0.51	2.056^{ns}	.145
D. Teaching Effectiveness	3.82	0.40	3.64	0.51	3.74	0.46	1.778^{ns}	.178
E. Professionalism	3.95	0.21	3.76	0.43	3.79	0.41	0.954^{ns}	.454

Note: * = significant ($p < .05$); ns = not significant ($p > .05$)

Table 6 indicates no significant differences in the perceived competency of personal skills, management skills, and educational planning when the teachers were grouped according to their highest educational attainment. The same observation is seen in teaching effectiveness and professionalism in their teaching performance regardless of their bachelor's or master's degree.

Table 6
Teaching Competencies Influencing the Teachers' Performance According to Highest Educational Attainment

Teaching Competencies	Bachelor's Degree		Master's Degree		*t*-value	*p*-value
	M	*SD*	*M*	*SD*		
A. Personal Skills	3.74	0.45	3.67	0.50	1.453^{ns}	.280
B. Management Skills	3.70	0.46	3.59	0.57	0.164^{ns}	.876
C. Educational Planning	3.68	0.47	3.68	0.49	0.468^{ns}	.653
D. Teaching Effectiveness	3.72	0.47	3.69	0.40	0.385^{ns}	.768
E. Professionalism	3.83	0.38	3.76	0.43	0.218^{ns}	.824

Note: * = significant ($p < .05$); ns = not significant ($p > .05$)

Results in Table 7 show no significant differences in the perceived effect of personal skills, management skills, and educational planning in teachers' teaching performance according to the number of years in service. Likewise, there is no significant difference in their teaching effectiveness and professionalism across the teachers' 1 - 30 years of teaching.

Table 7

Teaching Competencies Influencing the Teachers' Performance According to Years in Service

Teaching Competencies	1 - 10 years		11 - 20 years		21 - 30 years		*f*-value	*p*-value
	M	*SD*	*M*	*SD*	*M*	*SD*		
A. Personal Skills	3.66	0.48	3.76	0.46	3.69	0.48	2.467^{ns}	.085
B. Management Skills	3.69	0.46	3.65	0.51	3.42	0.65	0.354^{ns}	.875
C. Educational Planning	3.68	0.47	3.74	0.44	3.38	0.58	1.964^{ns}	.148
D. Teaching Effectiveness	3.72	0.47	3.75	0.46	3.43	0.63	1.356^{ns}	.285
E. Professionalism	3.84	0.37	3.77	0.42	3.67	0.48	0.432^{ns}	.830

Note: * = significant ($p < .05$); ns = not significant ($p > .05$)

The collected data of science MPS among the Grade 3, 4, 5, and 6 students is reported in Table 8. This MPS data indicated the student's academic achievement in science as assessed by the primary teachers. Notably, the data showed that all grade levels garnered an MPS close to 50%, indicating that the students have lower average science achievement levels. Consequently, it resulted in an overall science MPS of below-average level of achievement of 50.25%.

Table 8

Overall Mean Percentage Score of the Primary Students in Science

Grade Levels	*N*	MPS, %	Descriptive Equivalent
A. 3	55	50.20	Lower Average
B. 4	71	50.23	Lower Average
C. 5	79	50.28	Lower Average
D. 6	79	50.30	Lower Average
	Overall MPS	50.25	Lower Average

Table 9 determines the correlation results, indicating no significant association between the teaching competencies influencing the teachers' performance and the students' academic achievement in science. There is no correlation between the teachers' personal skills, management skills, educational planning, teaching effectiveness, and professionalism and their students' MPS in science.

Table 9

Correlation Between the Teaching Competencies and Mean Percentage Score

Teaching Competencies	*r*-value	*p*-value
A. Personal Skills	.0417^{ns}	.7357
B. Management Skills	.1017^{ns}	.4092
C. Educational Planning	.0437^{ns}	.7238
D. Teaching Effectiveness	-.0215^{ns}	.8622
E. Professionalism	.0265^{ns}	.8303

Note: * - significant ($p > .05$); ns - not significant ($p > .05$)

Discussion

Professionalism is ranked as the most perceived teaching competency that influences the teaching performance of primary science teachers. This is consistent with Darling-Hammond et al.'s (2017) affirmation that professional development for teachers is viewed as a way to help them reach a certain level of professional growth, improve their knowledge and proficiency, and provide a platform for behavior modification. Nonetheless, teachers must never forget that the elements of professional development should be structured so that teachers can demonstrate their qualifications in terms of knowledge, skills, and attitudes, as Nessipbayeva (2012) shared. This is while being able to comprehend the various needs of students. Professionalism among the teachers indicated their adherence to a set of standards and code of conduct within the academe. Precisely, in this study, the standards were measured in terms of attendance, punctuality, submitting requirements, wearing proper attire and uniforms, and effective communication with their colleagues. Their interest in improving themselves in their quality of teaching and their active participation in school activities were also included. Professionalism is a quality that every teacher must possess since they are perceived as the models of the students.

The teachers' perceptions of personal skills, management skills, educational planning, teaching effectiveness, and professionalism determined to be the same regardless of gender, agrees with Wood (2012) and Islahi and Nasreen (2013), showing no significant difference in the teaching styles between male and female teachers. This implies that both teachers have the same perception of the influence of their teaching competencies. Regarding age, the non-significant determination of management skills, educational planning, teaching effectiveness, and professionalism among the teachers is similar to the result of Sivasakthi Rafammal and Muthumanickam (2012), where age, either young, mature, or old, does not make any difference to teacher effectiveness. A significant difference in personal skills reveals diversity in how the teachers approach their work and handle various aspects of teaching. This confers with Chiang and Wang (2014), indicating that older teachers tended to make their own decisions. This may be reflected in the viewpoint that teachers generally lose the enthusiasm to teach as they grow old. Results indicated the non-significance in the educational attainment among the teachers. It does not reflect that of Kowalczuk-Waledziak et al. (2017), Tucker and Fushell (2013), and Sahlberg (2015), signifying that obtaining a higher degree has a beneficial influence. It conveys that the teaching competencies do not vary, even if the teachers have a bachelor's or master's degree. However, this may reflect Klassen and Tze (2014) and Ronfeldt et al. (2013), positing that more needs to be known about how graduate education affects teachers. There are also no significant differences in the teachers' perceptions of the teaching competencies according to their years in service. This entails that the teachers' perception of their competencies does not vary significantly based on longitude of experience. It does not agree with Unal and Unal (2012) and Sadik and Akbulut (2015), who denote that teachers with more years of teaching experience are more effective in teaching and sound in their teaching skills. This result suggests that the teachers, no matter how long their years in service were in teaching, still have excellent personal skills, management skills, educational planning, teaching effectiveness, and professionalism.

The general non-significance among the teaching competencies of the science teachers regarding their gender, age, highest educational attainment, and years in service suggests a degree of consistency and uniformity in their skills and capabilities. In the study's context, the teachers strongly agreed that they had displayed behaviors appropriate to professional status in their workplace. They have shown an enthusiastic outlook towards teaching. They possessed clear voices and proper intonations and observed proper grooming. They exhibited confidence, leadership, creativity, and initiative in their teaching responsibilities. The teachers showed efficiency in their routines, allowed maximum participation of their students, and prepared supportive learning experiences. They designed appropriate learning objectives, course materials, student activities or tasks, and evaluation instruments, such as rubrics. They were able to properly assess students' needs and abilities in order to address learning difficulties. Utilization of varied teaching methods and strategies, various motivational techniques, and praising students' achievements were done. The teachers have evaluated the effectiveness of their teaching practices in terms of objectives and implemented various motivational techniques in the teaching-learning process.

Meanwhile, the study found that the MPS of the students in science is 50.25%. This value is close to the quartile range of 26 – 50%, indicating a lower average. It is most likely congruent with the PISA 2022 result, where the scientific literacy among Filipino students was significantly lower compared to the other participating nations, as Chi (2023) and OECD (2023) reported. This highlights the circumstances surrounding the country’s K to 12 curricula, as Hernando-Malipot (2023) relayed. The low average achievement portrays the students’ low scientific literacy. It can be inferred that the students lack the fundamental knowledge, skills, and understanding necessary to engage and interpret scientific information critically. They may struggle to comprehend scientific principles, understand the nature of scientific inquiry, and assess science-related information. This deficiency can hinder their ability to participate in an increasingly complex and technology-driven world, limiting their capacity to make informed decisions on issues with scientific relevance.

In this study, the lack of correlation between the competencies influencing the science teachers' performance and the students' MPS stipulates that students' academic achievement and level of engagement were not influenced by the teachers' personal skills, management skills, educational planning, teaching effectiveness, and professionalism. This contrasts that of Abudu and Gbadamosi (2014), SACE (2010), and Moeini et al. (2018), implying a correlation between the teachers' abilities and effectiveness and students' achievement. It does not mirror that quality science teachers affect students' science learning, as Spaull (2013) and Tsanwani et al. (2014) asserted. This result suggests that the effectiveness of teachers, as measured by their competencies, does not align with or predict the academic success of students in science. However, it is important to recognize that student achievement is a multifaceted outcome influenced by various interconnected elements. While teaching competencies are undoubtedly crucial, the lack of correlation could stem from various factors, underscoring the complexity of educational outcomes and highlighting the need to explore additional factors that contribute to students' science achievement beyond the teachers' competencies.

Conclusions, Implications, and Limitations

The effectiveness of a science teacher in enhancing scientific literacy depends on their competence and ability to inspire and engage their students in the subject. This study assessed the teaching competencies influencing primary science teachers' teaching performance relative to their students' academic achievement in science. It has been identified that teachers strongly agreed that professionalism is the main teaching competency influencing their performance in science education. Likewise, the teachers strongly agreed regarding the other competencies of personal skills, teaching effectiveness, educational planning, and management skills. In general, it was determined that there are no significant differences among the teaching competencies that influenced the performance of science teachers regarding their gender, age, highest educational attainment, and years in service. The students' academic achievement in science is evaluated as below average, indicating a lower performance expectation. Conclusively, the study found no correlation between the teaching competencies and students' academic achievement in science. These findings offer significant perspectives on the elements that impact the quality of primary science education. Understanding teaching competency is essential for developing informed pedagogical approaches that empower teachers to create engaging and successful student learning experiences and academic achievement.

Based on the study's findings, the science teachers' competence implies a multifaceted proficiency beyond mere knowledge of scientific content. They possess the skills to design and deliver practical science lessons, adapting their approach to diverse learning styles. Their pedagogical skills are evident through implementing diverse teaching methods fostering student engagement and understanding. They have better personal qualities, are responsible, and excel in teaching and classroom management. They can create an atmosphere conducive to learning by effectively promoting student participation and managing behavior. They actively seek opportunities to enhance their teaching techniques and integrate relevant technologies. The lack of correlation between teaching competencies and academic achievement suggests that despite possessing the necessary skills and knowledge, teachers may face challenges in translating their competencies into tangible improvements in students' academic performance. Addressing this disassociation requires a comprehensive examination of assessment methods, curriculum design, and the broader educational context to ensure that teaching competencies align with and positively impact student learning outcomes.

Although the research has yielded valuable findings, various factors and limitations are to be considered when evaluating the constraints of this study. The coronavirus disease (COVID-19) pandemic has caused abrupt academic constraints in the district, affecting teaching and learning over the past few years. Even though regular classes had already been pursued, the pandemic may have affected teachers' responses and students' performances. Moreover, with the small number of science teacher participants in the district, the result does not represent a larger population. Nonetheless, the researchers still perceive that a competent, passionate, and knowledgeable science teacher plays a vital role in shaping students' scientific literacy, attitudes, and abilities regarding understanding and appreciating the world through a scientific lens.

Declaration of Interest

The authors declare no competing interest.

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THE IMPACT OF TECHNOLOGICAL STRESS ON ACADEMICS' LIFE SATISFACTION

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Abstract

Increasing research reveals the impact of technostress on life satisfaction among academics. In line with the determined purpose, it is first determined whether there is a significant difference in terms of technostress and life satisfaction between demographic variables such as age, gender, field of science and years of experience. Secondly, an answer was sought to the question of whether there was a significant impact of technostress on life satisfaction. To achieve the determined research purpose, the relational scanning model was used. The study involved 342 academic participants working at different universities in Kyrgyzstan who agreed to participate voluntarily. The research was conducted with 342 academics, 207 women and 135 men. To analyze the data obtained, t-test, one-way ANOVA, Pearson's correlation analysis and linear regression analysis were used. As a result of the research, it was determined that there was a low level of negative association between life satisfaction and the socially focused technostress sub-dimension score among the technostress sub-dimensions. Life satisfaction and general technostress level were determined to be permanent and significant among the technostress sub-dimensions such as profession-oriented, technical subject-oriented learning-teaching process-oriented and personal technostress sub-dimensions. The regression analysis revealed that general technostress emerged, but the sub-dimensions showed no influence on life satisfaction, and that single socially focused technostress had a negative predictive impact on life satisfaction.

Keywords*: academic productivity, life satisfaction, technostress, learning-teaching process*

Introduction

In the contemporary era, technology has become an integral aspect of our lives, particularly in education, where it has swiftly emerged as a paramount tool, especially amid the COVID-19 pandemic. To deliver a high-quality education in today's information age, there is a pervasive use of information and communication technologies to streamline academic processes across various dimensions of the educational journey, thereby enhancing the teaching and learning experience (Upadhyaya & Vrinda, 2021). Beyond its role in curricula and assessments, promoting the incorporation of technology in teaching is essential to facilitate learning, making it unavoidable for educators to embrace technological tools and stay abreast of their ongoing development. Technology offers substantial benefits in terms of heightened productivity and efficiency, concurrently shaping new living conditions (Lee et al., 2016). However, the positive impacts of technology-driven changes are accompanied by negative repercussions, such as stress, fear and anxiety, as individuals endeavor to stay abreast of these advancements (Fernández-Batanero et al., 2021; Maples-Keller et al., 2017). The insufficient technological proficiency of teachers or their challenges in handling technical issues can lead to disappointment and psychological pressure, constituting adverse outcomes of information

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and communication technologies (Chiappetta, 2017). The adverse effects of technology were first conceptualized as "Technostress" by the American psychologist Brod in 1984. According to Brod (1984), technostress is an adaptation disease that happens when people have trouble dealing with new computer technology. Alternatively, Weil and Rosen (1997) characterized technostress as the unfavorable effect of technology on individuals' attitudes, behaviors, thoughts, and psychology, whether directly or indirectly. Despite the varying definitions, Jena (2015), Kim and Lee (2021) have agreed that stress and anxiety caused by changes in information and communication technologies can be called technostress.

It is increasingly apparent that adverse consequences stemming from technology can impact various aspects of life. Examining recent studies investigating the correlation between technostress and other phenomena reveals a diverse range of subjects explored in the literature. These encompass studies on job satisfaction (Aktan & Toraman, 2022; Ranathunga & Rathnakara, 2022; Toraman & Aktan, 2022), professional motivation (Akman & Durgun, 2022), academic productivity (Akman & Durgun, 2022; Fernández-Fernández et al., 2023), well-being and academic achievement (Whelan et al., 2022), techno-pedagogical competence (Gökbulut, 2021), professional burnout (Gökbulut & Dindaş, 2022), perceived organizational support (Solís et al., 2023), job condition satisfaction and perceived work balance (Al-Ansari et al., 2023), job condition satisfaction and perceived performance (Al-Ansari et al., 2019), psychological capital (Efilti & Çoklar, 2019), and work-family conflict (Shaukat et al., 2022). Furthermore, there are studies investigating the correlation between technostress and life satisfaction (Lee et al., 2016; Le Roux & Botha, 2021; Shaukat et al., 2022). Lee et al. (2016) and Le Roux and Botha (2021) observed in their research that technostress negatively influences life satisfaction. However, Shaukat et al. (2022) asserted a positive association between technostress and life satisfaction. The findings have demonstrated that the utilization of technology can lead to favorable outcomes for individuals, contributing to increased life satisfaction in certain cases. The different results have shown that it may be due to the differences in the research methods used in the studies, sample sizes, different characteristics of the participant groups and other variables.

Introduced by Neugarten in 1961, the concept of life satisfaction is defined as individuals' positive assessment of their lives based on criteria they establish (Diener et al., 1985). Put differently, life satisfaction arises from the comparison of individuals' life expectations with their actual situations (Özer & Karabulut, 2003), that is, the individual's conscious experience of positive emotions against negative emotions (Frish, 2005). Greater contentment with one's circumstances and life situation correlates with higher levels of life satisfaction. This situation affects people's family life, work, and other areas of their lives equally (Diener & Seligman, 2002; Leung & Leung, 1992). Based on this definition, negatively affecting the life satisfaction of individuals can negatively affect their work and family life and other areas of their life.

Research Aim and Research Questions

The aim of the research was to determine the impact of technological stress (technostress) on academics' life satisfaction. The starting point of this research was the proliferation of information communication technologies across organizations and therefore affecting non-technologist people and the limited number of studies conducted on academics on the subject focused on experts (academics). Furthermore, this study addresses existing gaps by examining the levels of technostress among teachers (academics) and determining the impact of technostress on life satisfaction within a developing country such as Kyrgyzstan. In this context, in Kyrgyzstan, online teaching is a relatively recent concept, and universities have only recently begun to develop and provide online programs. The research endeavors to provide valuable insights into the dynamics of technostress and its effects on the well-being of educators in a context where online education is still in its early stages of implementation. In this context, the researcher used the following research questions to achieve the main purpose of the study:

1. What are the academics' technostress and life satisfaction levels?
2. Are there significant differences in technostress and life satisfaction levels among academics based on variables such as gender, age, science field, and seniority?
3. Is there a significant association between academics' technostress and life satisfaction levels?
4. Do academics' technostress levels impact their life satisfaction levels?

Research Methodology

General Background

The research falls within the realm of quantitative research, with a focus on examining technostress and life satisfaction among academics in Kyrgyzstan during the year 2023. To achieve the determined research purpose, the relational scanning model was used. The quantitative research approach, categorized as research approaches aiming to depict a current or past situation, particularly highlights the relational scanning model's function, which is to identify and measure the existence or extent of associations between two or more variables (Karasar, 2014). The study was grounded in the work-life balance theory, which emphasizes a balance between work and life. This framework informed the development of research tools and analysis techniques, promoting a holistic understanding of the issues studied.

Sample Selection

The study's population comprises academics employed at universities in Kyrgyzstan during the 2022-2023 academic year. According to the latest report, a total of 12039 academics work in universities in Kyrgyzstan (National Statistics Committee of the Kyrgyz Republic, 2022). The participants were selected through the convenience sampling method, a non-probability sampling approach that involves selecting individuals based on their convenient accessibility or availability to the researcher. (Ekiz, 2015). The research was conducted with 342 academics, 207 women and 135 men, from four universities in Kyrgyzstan, who participated in the study voluntarily. Table 1 outlines the demographic and descriptive statistics of the sample group.

Table 1
Some Demographic Characteristics of the Participants (n=342)

	Group	*n*	%
Gender	Female	207	60.5
	Male	135	39.5
Age	27-40 years	116	33.9
	41-55 years	143	41.8
	56 and over years	83	24.3
Science Field	Social Science	104	30.4
	Science	238	69.6
Seniority	1-15 years	123	36
	16-30 years	137	40
	31 and over years	82	24

60.5% (n = 207) of the sample of the study was female, and 39.5% (n = 51) were male academics. Reviewing the age ranges of the participants, 41.8% (*n* = 143) of the participants were 41-55 years old, 33.9% (*n* = 116) were 27-40 years old, and 24.3% (*n* = 83) were 56 years old and over. While 69.6% (*n* = 238) of the participants are in the field of social sciences, 30.4% (*n* = 104) are in the field of sciences. According to the variable of seniority years, 40% (*n* = 137) of the participants had 16-30 years, 36% (*n* = 123) 1-15 years, 24% (*n* = 82) had 31 years and more than ten years of seniority. Participation was ensured by obtaining a consent form from the participants, in which they declared that they participated voluntarily.

Instrument and Procedures

The researcher collected the study data with the Personal Data Form, "Defining Teachers' Technostress Levels Scale" developed by Çoklar et al., 2017) and adapted to Kyrgyz by Efilti and Zhumgalbekov (2023), and "Life Satisfaction Scale" developed by Diener et al., (1985) and adapted to Kyrgyz by Borkoev et al. (2019).

1. *Personal Data Form*

This form, created by the researcher, includes the demographic information of the participants (gender, age, science field, seniority).

2. *Defining Teachers' Technostress Levels Scale*

The scale comprises 28 items categorized into 5 factors. The factors are "Profession Oriented", "Learning-Teaching Process Oriented", "Personal Oriented", "Technical Subject Oriented" and "Social Oriented". The scale items are 5-point Likert type and are "Totally Agree", "Agree", "Partly Agree", "Disagree" and "Strongly Disagree". The Cronbach's alpha coefficient for the entire scale was found to be .917, signifying a robust level of internal consistency. Additionally, the Spearman-Brown coefficient, computed when the scale was divided into two halves, was found to be .845. These coefficients serve as measures of the reliability of the scale, demonstrating its consistency in assessing the underlying construct. The internal consistency coefficients (Cronbach's alpha) for the individual factors comprising the scale range from .712 to .788. The interpretations of the findings obtained are reliant on calculations made using the arithmetic mean score during the analysis of the data. The criteria for evaluating the technostress levels of academics in the scale are as follows: 3.68 – 5.00 – high level, 2.34 – 3.67 – medium level, 1.00 – 2.33 – low level (Çoklar et al., 2017). A strong positive correlation was identified between the initial Turkish version and the Kyrgyz adaptation of the scale ($r = .798$, $p < .01$). Following the analysis, a measurement instrument comprising 27 items and 5 subscales, elucidating 63.74% of the total variance, was derived. Furthermore, it was observed that the items within the sub-dimensions precisely corresponded to those in the original form. The internal consistency coefficient of the Kyrgyz version of the scale was calculated as $\alpha = .95$ and the internal consistency coefficient of the 5 subscales ranged between 0.77-0.85. The correlation value of the test-retest method was calculated as .811 (Efilti & Zhumgalbekov, 2023).

3. *Life Satisfaction Scale*

The Life Satisfaction Scale, formulated by Diener et al. (1985), was adapted into the Kyrgyz language by Borkoev et al. (2019). The original version of the scale is a self-assessment scale comprising 5 Likert-type items, ranging from "I totally agree" (5) to "I totally disagree" (1). In the Kyrgyz adaptation of the scale, 5 items remained hidden, but its type was changed to 7 Likert. A general score is obtained by summing the values of the options marked on the scale, and the maximum score that can be obtained is 35. In scoring the original scale, the arithmetic mean of the group is used to determine those with high and low life satisfaction. Those who are above the arithmetic average are determined as having high life satisfaction, those below the arithmetic average are determined as low life satisfaction. The coefficient of internal consistency of the Kyrgyz-language version of the life satisfaction scale was calculated as α = .751. The correlation value for the test-retest method was computed as .642. A positive significant association was found between the two results of the life satisfaction scale.

Data Collection

In order to collect the data, the researcher created the instruments electronically on Google Forms and sent the prepared form to the target audience via the Internet and applied it. The participants took care to include information on how to answer the questions on the first pages of the instruments.

Data Analysis

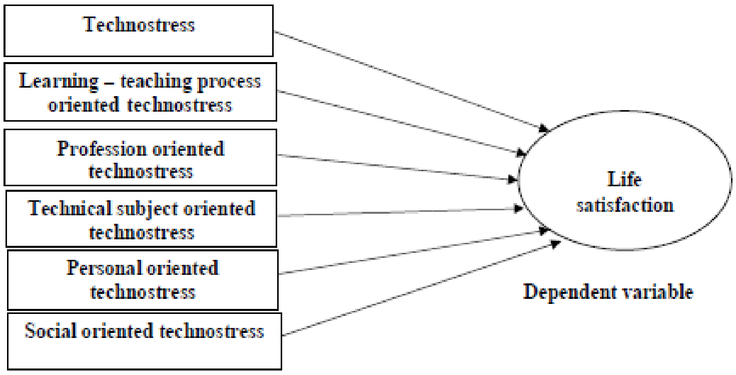
To decide whether to employ parametric or non-parametric tests for data analysis, an assessment of the data's normal distribution was conducted. In studies conducted in the field of social sciences, understanding whether the data has a normal distribution feature is mostly provided by the values of skewness and kurtosis. Tabachnick and Fidell (2013) articulated that if these values are between -1.5 and +1.5, it is accepted that the data satisfies the condition of normal distribution. Statistics package application was used in the analysis of the data.

Table 2
Kurtosis and Skewness Values of the Data

Variables	Skewness	Kurtosis
Technostress (Total Score)	.106	.041
1. Learning – teaching process oriented	-.008	-.102
2. Profession oriented	.366	.123
3. Technical subject oriented	.137	.033
4. Personal oriented	.247	-.207
5. Social oriented	.330	-.092
Life Satisfaction	-1.099	1.412

As seen in the table, the skewness and kurtosis values of the data are between -1.5 and +1.5. The researcher analyzed the results of the histogram, Q-Q Plot, Boxplot charts and Kolmogorov-Smirnov (K-S) (significance value was insignificant for all scales) test ($p \geq .05$) to decide on the normal distribution. Accordingly, with the data meeting the normal distribution criterion, the decision was made to employ parametric tests. Having normal distribution in measurements and using parametric tests give stronger results (Pallant, 2017). In this framework, the researcher applied the Pearson Product Moment Correlation Test for correlational analysis between dependent variables, a t-test for Independent Samples a One-Way ANOVA test for analysis of demographic variables, and Simple Linear Regression analysis to look at the predictive status among dependent variables. If the researcher found a significant difference according to the results of the t-test, the effect size of the significance was determined with the eta square (η^2) formula and reported with the eta square value (Table 2).

Figure 1
Conceptual Model of the Research


Technostress
Learning – teaching process oriented technostress
Profession oriented technostress
Technical subject oriented technostress
Personal oriented technostress
Social oriented technostress
Life satisfaction
Dependent variable

Research Results

The findings of the research are presented below in order.

Table 3
Cronbach's Alpha Values and Descriptive Statistics for All Variables

Variables	*N*	$\bar{x}$	*SD*	α	Level
Technostress (Total Score)	342	2.69	.508	.918	Medium
1. Learning – teaching process oriented	342	2.75	.595	.757	Medium
2. Profession oriented	342	2.41	.636	.786	Medium
3. Technical subject oriented	342	2.96	.626	.784	Medium
4. Personal oriented	342	2.40	.665	.825	Medium
5. Social oriented	342	2.94	.671	.796	Medium
Life Satisfaction	342	537	1.010	.763	High

Note. $\bar{x}$ = Mean, *SD* = standard deviation, α = Cronbach alpha reliability

The mean score for technostress of academics was 2.69, and the mean score for life satisfaction was 5.37. The mean scores of the technostress subdimensions were determined to be 2.75 for the learning-teaching process oriented, 2.41 for the profession oriented, 2.96 for the technical subject oriented, 2.40 for the personal oriented and 2.94 for the social oriented dimension. The data show that the personal oriented and profession oriented subdimensions have the lowest mean scores, while the social oriented and technical subject-oriented dimensions have the highest mean scores. On the other hand, participants generally have moderate technostress levels and high levels of life satisfaction. The Cronbach's Alpha coefficients of the variables show that the data are at a very reliable level (Table 3).

In order to analyze whether the life satisfaction and technostress levels of the academics differ by the gender variable, a *t*-test was performed for independent samples (Table 4).

Table 4

t-test Results for Independent Samples Regarding the Difference of Technostress and Life Satisfaction Levels by the Gender Variable

Variables	Gender	*n*	$\bar{x}$	*SD*	*t*	*df*	*p*
Technostress (Total Score)	Female	207	2.72	.46	1.175	340	.24
	Male	135	2.65	.57			
1. Learning – teaching process oriented	Female	207	2.76	.56	0.218	340	.,83
	Male	135	2.75	.65			
2. Profession oriented	Female	207	2.45	.58	1.397	340	.16
	Male	135	2.35	.70			
3. Technical subject oriented	Female	207	3.04	.59	1.611	340	.11
	Male	135	2,.89	.66			
4. Personal oriented	Female	207	2.43	.64	0.991	340	.32
	Male	135	2,.36	.70			
5. Social oriented	Female	207	2.96	0.65	.617	340	0.53
	Male	135	2.92	0.71			
Life Satisfaction	Female	207	5.36	1.04	-.261	340	0.79
	Male	135	5.39	0.97			

Note. SD = standard deviation, $\bar{x}$ = Mean, *df* = degree of freedom

Table 4 shows that the general technostress levels of academics do not differ statistically from the gender variable [*t*(340) = 1.175; *p* > .05]. The scores of the technostress subdimensions did not differ significantly by the gender variable (*p* > .05). Among the technostress subdimensions, the highest mean score of females and males was in the social oriented subdimension, and the lowest mean score was in the personal oriented subdimension. However, the level of life satisfaction in academics did not show a statistically significant difference by the gender variable [*t*(340) = -.261; *p* > .05]. However, both females and males had a moderate technostress score and a high level of life satisfaction.

Table 5 shows the differences in the technostress and life satisfaction levels of the participants by the age variable.

Table 5

One-Way ANOVA Test Results Regarding the Differences in Technostress and Life Satisfaction Levels by the Age Variable

Variables	Age	*n*	$\bar{x}$	*SD*	*F*	*df*	*p*	Levene's Test	Significant Difference
Technostress (Total Score)	1) 27-40	116	2.62	.49	1.822	2	.16	.322	
	2) 41-55	143	2.72	.48					
	3) 56 and more	83	2.74	.55					
1. Learning – teaching process oriented	1) 27-40	116	2.73	.58	0.348	2	.71	.139	
	2) 41-55	143	2.75	.57					
	3) 56 and more	83	2.79	.66					
2. Profession oriented	1) 27-40	116	2.29	.64	3.450	2	**.03***	.181	1-3
	2) 41-55	143	2.46	.59					
	3) 56 and more	83	2.50	.69					
3. Technical subject oriented	1) 27-40	116	2.86	.64	2.331	2	.10	.620	
	2) 41-55	143	2.99	60					
	3) 56 and more	83	3.04	.64					
4. Personal oriented	1) 27-40	116	2.28	.64	3.222	2	**.04***	.839	1-3
	2) 41-55	143	2.45	.68					
	3) 56 and more	83	2.48	.65					
5. Social oriented	1) 27-40	116	2.97	.70	1.676	2	.19	.315	
	2) 41-55	143	2.99	.63					
	3) 56 and more	83	2.83	.69					
Life Satisfaction	1) 27-40	116	5.26	1.12	1.199	2	.30	.136	
	2) 41-55	143	5.38	.94					
	3) 56 and more	83	5.49	.95					

Note. SD = standard deviation, $\bar{x}$ = Mean,*: $p < .05$

Table 5 indicates that the overall technostress levels among academics did not exhibit a statistically significant difference based on the age variable [$F(2) = 1.822$; $p > .05$]. The learning-teaching process oriented [$F(2) = .348$; $p > .05$], technical subject oriented [$F(2)= 2.331$; $p > .05$] and social oriented [$F(2)= 1.676$; $p > .05$] technostress levels did not differ, while the profession oriented [$F(2) = 3.450$; $p < .05$] and personal oriented [$F(2) = 3.450$; $p < .05$] technostress levels differed statistically significantly by the age variable. The Tukey test was employed to identify between which groups this difference existed, as the result of Levene's test did not yield significance. As a result of the test, there was a significant difference between the academics aged 27-40 and the academics aged 56 and over. The eta-square effect size coefficient analysis showed that this difference had a low effect on the variance (η2 = .02).

The results of the analysis showed that the level of life satisfaction of academics did not differ statistically by the age variable [$F(2)= 1.199$; $p > .05$].

The differentiation status of the participants' technostress and life satisfaction levels according to the field of science variable is given in Table 6:

Table 6
T-test Results for Independent Samples Regarding the Variation of Technostress and Life Satisfaction Levels by Science Field Variable

Variables	Science Field	*n*	$\bar{x}$	*SD*	*t*	*df*	*p*	(η^2)
Technostress (Total Score)	Social Science	104	2.67	.48	-.228	340	.82	
	Science	238	2.69	.52				
1. Learning – teaching process oriented	Social Science	104	2.77	.56	.482	340	.63	—
	Science	238	2.74	.61				
2. Profession oriented	Social Science	104	2.32	.65	-1.862	340	.06	—
	Science	238	2.45	.63				
3. Technical subject oriented	Social Science	104	2.98	.61	.373	340	.71	—
	Science	238	2.95	.64				
4. Personal oriented	Social Science	104	2.31	.68	-1.758	340	.08	—
	Science	238	2.44	.66				
5. Social oriented	Social Science	104	3.07	.66	2.338	340	**.02***	.02
	Science	238	2.88	.67				
Life Satisfaction	Social Science	104	5.09	1.03	-3.510	340	**.001****	.04
	Science	238	5.50	.98				

Note. SD = standard deviation, $\bar{x}$ = Mean, **: $p < .05$, **: $p < .01$*

While the general technostress levels of academics and the scores of the subdimensions of profession-oriented, learning-teaching process-oriented, personal-oriented, and technical subject-oriented did not differ by the science field variable ($p > .05$), the social oriented subdimension score differed statistically significantly [$t(340) = 2{,}338$; $p < .05$]. The result shows that academics in the field of social sciences have higher social-oriented technostress levels. The eta-square effect size coefficient of this difference was computed as $\eta^2 = .02$, and the difference had a low effect on the variance (Table 6).

The results of the analysis showed that the level of life satisfaction of academics differed statistically by the variable of the science field [$t(340)= -3.510$; $p < .01$]. The result shows that academics in the science field have higher levels of life satisfaction. The eta-square effect size coefficient for this difference was computed as $\eta^2 = .04$. The result shows that this difference has a low effect on the variance (Table 6).

The differentiation status of the participants' technostress and life satisfaction levels by the seniority variable is given in Table 7.

Table 7

One-Way ANOVA Test Results Regarding the Variation of Technostress and Life Satisfaction Levels by Years of Seniority Variable

Variables	Year	*n*	$\bar{x}$	*SD*	*F*	*df*	*p*	Levene's test	Significant difference
Technostress (Total Score)	1) 1-15	123	2.66	.48	1.042	2	..35	.346	
	2) 16-30	137	2.67	.49					
	3) 31 and more	82	2.75	.56					
1. Learning – teaching process oriented	1) 1-15	123	2.79	.55	1.466	2	.23	.059	
	2) 16-30	137	2.68	.59					
	3) 31 and more	82	2.81	.66					
2. Profession oriented	1) 1-15	123	2.35	.63	1.428	2	.24	.085	
	2) 16-30	137	2.41	.58					
	3) 31 and more	82	2.50	.72					
3. Technical subject-oriented	1) 1-15	123	2.88	.61	2.161	2	.12	.997	
	2) 16-30	137	2.96	.63					
	3) 31 and more	82	3.06	.63					
4. Personal oriented	1) 1-15	123	2.30	.68	3.143	2	.04*	.726	1-3
	2) 16-30	137	2.42	.63					
	3) 31 and more	82	2.53	.66					
5. Social oriented	1) 1-15	123	3.01	.68	.985	2	.38	.365	
	2) 16-30	137	2.93	.62					
	3) 31 and more	82	2.88	.73					
Life Satisfaction	1) 1-15	123	5.21	1.14	2.517	2	.08	.143	
	2) 16-30	137	5.44	.93					
	3) 31 and more	82	5.49	.92					

Note. $\bar{x}$ = Mean, *SD* = standard deviation, **: $p<.05$*

In Table 7, as a result of the ANOVA test conducted to determine the group differences, the general technostress levels of the academics and the scores of the profession-oriented, learning-teaching process-oriented, social-oriented, and technical subject-oriented subdimensions did not differ by the seniority variable ($p > .05$), but the score of personal oriented subdimension differed statistically significantly [$F(2) = 3.143$; $p < .05$]. The Tukey test was utilized to identify the specific groups between which this difference existed, as the result of Levene's test did not reach statistical significance. The test results revealed a significant difference between academics with 1-15 years of seniority and those with 31 or more years of seniority. The result shows that academics with 1-15 years of seniority have lower personal technostress levels. The eta-square effect size coefficient analysis showed that this difference had a low effect on the variance ($\eta^2 = .02$).

The analysis results indicated that the life satisfaction level of academics did not exhibit a statistically significant difference based on the seniority variable [$F(2) = 2.517$; $p > .05$].

Table 8 shows the findings of the correlation test, which was conducted to determine the associations between the participants' technostress levels and their life satisfaction levels:

Table 8
Results of Pearson Test (n =342)

	Technostress (Total Score)	1	2	3	4	5	6
Technostress (Total Score)	1						
1. Learning – teaching process oriented	.787**	1					
2. Profession oriented	.832**	.564**	1				
3. Technical subject-oriented	.812**	.506**	.553**	1			
4. Personal oriented	.817**	.498**	.688**	.583**	1		
5. Social oriented	.752**	0.98**	.491**	.616**	.528**	1	
6. Life Satisfaction	-.091	-.050	-.048	-.081	-.068	-.139**	1

***: p<.01*

In Table 8, the statistically significant associations show that there is a low level of negative statistically significant association between life satisfaction score and socially oriented technostress subdimension score [$r = .139$; $p < .01$]. Accordingly, as the socially oriented technostress level increases, the life satisfaction level score decreases. Life satisfaction score and general technostress level score [$r = -.091$; $p > .05$], learning-teaching process oriented [$r = -.050$; $p > .05$], profession oriented [$r = -.048$; $p > .05$], technical subject oriented [$r = -.147$; $p < .01$] and personal oriented [$r = -.147$; $p < .01$] subdimensions scores were not found to be statistically significant. Nevertheless, statistically significant positive correlations were observed between technostress and its subdimensions.

Table 9 presents the findings regarding the prediction of life satisfaction by technostress and its subdimensions:

Table 9
Results of Linear Regression Analysis

Independent Variable	B(b)	SE of B	Beta	*t*	*p*
Technostress (Total Score)	-.181	.107	-.091	-1.687	.093
Invariant (a)	5858	.293		19.966	.001
			R^2=0,008 F= 2,846 p=.093		
1. Learning – teaching process oriented	-.085	.092	-.050	-.930	.353
Invariant (a)	5.607	.259		21.661	.001
			R^2= .003 F= .864 p= .353		
2. Profession oriented	-.077	.086	-.048	-.890	.374
Invariant (a)	5.557	.215		25.899	.001
			R^2= 0.002 F=.793 p= .374		
3. Technical subject oriented	-.130	.087	-.081	-1.495	.136
Invariant (a)	5.757	.264		21.842	.001
			R^2= .007 F= 2.234 p= .136		
4. Personal oriented	-.103	.082	-.068	-1.254	.211
Invariant (a)	5.619	.205		27.450	.001
			R^2= .005 F=1.571 p= .211		
5. Social oriented	-.210	.081	-.139	-2.597	**.010**
Invariant (a)	5.989	.244		24.559	**.001**
			*R^2= .02 F=6.743 p= **.010***		

Note. SE = Standard Error, *a* = Dependent variable: Life satisfaction

As a result of the linear regression analysis to analyze the impact of technostress and its sub-dimension scores on the total life satisfaction score, the fixed parameter was statistically significant ($p < .001$), and among the technostress sub-dimensions, only the slope parameter of the socially oriented sub-dimension score ($t = -2.597$; $p < .01$) was statistically significant. Following the F-test ($F = 6.743$; $p \leq .01$), it was concluded that the model is generally significant, and the coefficient of determination was .02. 2% of the participants' life satisfaction score is explained by the life satisfaction score, and when other variables are kept constant, a 1-unit increase in the social oriented subdimension score will decrease the life satisfaction score by -.210 points.

According to the results of general technostress and profession oriented, learning-teaching process oriented, personal oriented and technical subject-oriented sub-dimensions, the regression is not important, since the significance value of the F test is greater than .05 ($p > .05$). Thus, it is the case that this regression equation cannot predict. However, since the significance value of the t-test is greater than .05 ($p > .05$), the parameter is not important. This result shows that general technostress, profession oriented, learning teaching process oriented, personal oriented and technical subject-oriented technostress do not have a significant impact on life satisfaction.

Discussion

In the study, the impact of technostress on life satisfaction was analyzed. In the Kyrgyz literature, no studies were found to compare the results obtained. Therefore, research from other countries is often used in the evaluations and discussions in this section.

The participants exhibited a moderate level of technostress, as determined by the study. However, it was observed that the participants generally reported a high level of life satisfaction. This suggests that their scores on the scales surpassed the mean scores of the maximum possible score. In alignment with the study's findings, Çoklar et al. (2016) and Gökbulut (2021) similarly identified moderate levels of technostress in their research involving teachers. These results imply that the stress associated with technology use among academics and educators is moderate, falling neither excessively high nor exceedingly low. A moderate level of technostress may indicate that participants encounter some challenges in adapting to technology, but this circumstance does not significantly impede their overall job performance or life satisfaction.

The study revealed that there was no statistically significant difference in the overall technostress levels among academics, and the scores for technostress subdimensions did not vary significantly based on gender. This finding aligns with outcomes from various studies on the topic available in the literature. Çoklar et al. (2016), Gokbulut (2021), Le Roux and Botha (2021), and Akman and Durgun (2022) reported that gender did not play a significant role in teachers' technostress levels. Similarly, Gökbulut and Dindaş (2022), employing the same scale in their research, found no notable difference between gender and factors related to the teaching-learning process or the profession. However, contrary to these findings, they identified a significant difference in gender concerning overall technostress and subdimensions like technical subject-oriented, social-oriented, and personal-oriented factors. In their study, female teachers exhibited higher technostress levels than their male counterparts, a result supported by other studies as well. Abd Aziz et al. (2021), Ahmad and Amin (2012), Aktan and Toraman (2022), Shaukat et al. (2022), Solis et al. (2023), and Upadhyaya and Vrinda (2021) all found that gender significantly influenced teachers' technostress levels, with females experiencing higher technostress than males. In conclusion, while this study indicates no significant gender-based difference in technostress levels, it is noteworthy that the association between gender and technostress can be intricate and diverse, as different studies yield varying results. Nonetheless, it was established that the life satisfaction levels of academics did not exhibit a statistically significant difference based on the gender variable. In parallel with the study findings, Ergün and Nartgün (2016); Yurttaş and Hırlak (2023) found that the life satisfaction levels of academics did not differ by the gender variable. On the contrary, Toker (2012) found that the life satisfaction levels of academics differed by the gender variable, and life satisfaction levels of males were higher than females.

It was found that the overall technostress levels among academics did not demonstrate a statistically significant difference based on the age variable. While the technical subject-oriented, learning-teaching process-oriented and social-oriented technostress levels did not differ, the personal-oriented and profession-oriented technostress levels differed statistically by the age variable. The personal-oriented and profession-oriented technostress levels of the academics in the 27-40 age range are lower than those in the other age ranges. Akman and Durgun (2022), Le Roux and Botha (2021) found that teachers' technostress levels did not differ by the age groups, while Shaukat et al. (2022) identified an age group distinction in the technostress variable, with teachers in the older age group experiencing higher levels of technostress. Based on this result, teachers in the older age group may have adopted technology in a later period and this may cause them to resist changes and innovations related to technology. In addition, it can be inferred that the need for new skills and knowledge regarding the use of technology can increase technostress for teachers who have been teaching with traditional methods for many years.

However, it was determined that the life satisfaction levels of academics did not differ statistically by the age variable. Contrary to the study result, Nair et al. (2021); Toker (2012); Yurttaş and Hırlak (2023) found that the life satisfaction of academics differs by the age variable. Across the literature, it was consistently observed that the older age group exhibited higher levels of life satisfaction than other age groups.

It was found that while the general technostress levels of academics and their subdimension scores of the profession oriented, learning-teaching process oriented, technical subject oriented, and personal oriented did not differ by the science field variable, the scores of the social oriented subdimension differed statistically. It was also determined that the social science academics' social-oriented technostress levels are higher than those of the scientists. The reason for this result may be that the technology use requirements of social sciences are higher than those of science and that social scientists use technology more frequently and in a complex way. Intensive use of digital technology may be required in data collection, analysis and sharing processes of research in social sciences, which may increase socially oriented technostress in academics. No studies were found in the literature that analyzed the differentiation status of technostress levels among academics based on the science field variable.

The life satisfaction levels of academics differ by the science field variable. Academics in the field of science exhibit higher levels of life satisfaction compared to those in social sciences. In the literature, no studies were found in which the differentiation status of the technostress levels of academics by the science field variable was analyzed.

As a result of the study, it was determined that while the general technostress levels of the academics and their scores of the profession oriented, learning-teaching process oriented, technical subject oriented, and social oriented subdimensions of the academics did not differ, the scores of the personal oriented sub-dimension differed statistically by the seniority variable. It was concluded that a significant difference existed between academics with 1-15 years of seniority and those with 31 or more years of seniority. This situation shows that academics with 1-15 years of seniority have lower personal technostress levels. Aktan and Toraman (2022), Çoklar et al. (2016); Gokbulut (2021); Gökbulut and Dindaş (2022) found no significant difference between teachers' technostress levels and their professional seniority levels, indicating that seniority had no impact on technostress levels.

It was determined that the life satisfaction levels of academics did not differ statistically by the seniority variable. In parallel with the study findings, Yurttaş and Hırlak (2023) determined that the level of life satisfaction of academics did not differ by their professional seniority. In contrary to the study findings, Ergun and Nartgun (2016); Nair et al. (2021), Toker (2012) found that there was an association between these two variables. Teachers with more years of seniority were found to have higher levels of life satisfaction.

There was a low level of negative statistically significant association between life satisfaction and social oriented technostress subdimension score. Accordingly, as the level of social oriented technostress increases, the level of life satisfaction decreases. However, it was determined that there was no statistically significant association between life satisfaction and general technostress level and profession oriented, learning-teaching process oriented, technical subject oriented and personal oriented technostress subdimensions. In their studies, Lee et al. (2016) and Le Roux and Botha (2021) discovered that technostress exerts a negative impact on life satisfaction. However, Shaukat et al. (2022) determined that there was a positive association between technostress and life satisfaction. These results showed that the use of technology can also have positive results among people, and technology can increase life satisfaction of people in some cases. These different results show that it may be due to the differences in the methods used in the studies, sample sizes, different characteristics of the participant groups and other variables.

As a result of the study, it was determined that the general technostress level and the profession oriented, learning-teaching process oriented, technical subject oriented and personal oriented technostress subdimensions did not have a significant impact on life satisfaction. However, it was identified that the social-oriented technostress subdimension had a negative predictive impact on life satisfaction. Lee et al. (2016) and Le Roux and Botha (2021) determined that technostress had a negative effect on life satisfaction. However, Shaukat et al. (2022) indicated that technostress positively affected life satisfaction.

Conclusions and Implications

Online teaching is a very new method for Kyrgyzstan, which is a developing country trying to catch up with innovations in academic life in this process. Due to this, this study aimed to determine the impact of technostress on the life satisfaction of academics working in university education in Kyrgyzstan. As a result of the research, it was determined that there was a low-level negative, statistically significant association between life satisfaction and the socially focused technostress sub-dimension score among the technostress sub-dimensions. It has been determined that there is no statistically significant association between life satisfaction and general technostress level, and among the technostress sub-dimensions.

As a result of the regression analysis, it was determined that the general technostress level and its sub-dimensions had no impact on life satisfaction, and that single socially focused technostress had a negative predictive impact on life satisfaction. One particularly striking issue among the findings is that academics in the field of social sciences experience much more technostress. Depending on this result, it is important to eliminate the technological deficiencies of academics working in the fields of social sciences and to equip them with equipment suitable for the rapidly changing technology of the 21st century. In this digital age, where information increases at a much faster rate than in previous periods, every academician needs to acquire the knowledge and skills to master innovations. Encouraging academics and providing them with supportive opportunities in this regard will help control technostress levels.

The examination of technostress and its impact on life satisfaction is a crucial area that warrants further academic investigation. This issue holds significant relevance as it intersects with key aspects like job satisfaction, performance, productivity, and burnout. Conducting studies on technostress and life satisfaction within the academic context has the potential to provide valuable insights for university administrations and educators, ultimately contributing to the enhancement of educational quality. By delving into the dynamics of technostress and life satisfaction, academia can gain a nuanced understanding of how these factors influence job stress, job satisfaction, burnout, job performance, intention to leave, and managerial support. Such comprehensive studies have the potential to offer actionable insights that can inform strategies to improve the overall well-being of university faculty and staff, leading to a positive impact on the quality of education provided. It is advisable to consider repeating these studies within specified time frames to capture evolving trends and dynamics in the academic environment.

Declaration of Interest

The authors assert no conflicts of interest.

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PROBLEMS
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TURKISH PRIMARY SCHOOL STUDENTS' INVOLVEMENT IN CLASSROOM ACTIVITIES

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Abstract

Measuring students' interest and involvement in classroom activities at all stages of education, from pre-school to upper secondary school, provides a better understanding of learning processes that enable the acquisition of abilities specific to a certain field. The purpose of this cross-age study was to investigate primary school students' involvement level in classroom activities. The sample consisted of 560 students studying in the first, second, third, and fourth grades at primary schools affiliated with a city in Turkey's inner Aegean area. The data were collected through "The Demographic Information Form" and "Leuven Involvement Scale". The research revealed that students in the 1st, 2nd, 3rd, and 4th grades in primary school had a moderate involvement level. It was found that there was a significant difference between the involvement levels of primary school students and the gender, course type, and professional experience of the teacher, but there was no significant difference between the grade levels of the students. It was recommended to use current methods and strategies to increase the level of involvement of students in classroom activities and to make arrangements to improve involvement in the learning environment.
Keywords: *behavioral engagement, cross-age study, level of involvement, primary school, primary student*

Introduction

The quality of learning processes and the factors affecting academic achievement in different levels of education have been increasingly emphasized in recent years. Research on students' interactions with educational settings and the opportunities that enhance their learning processes has gained traction. Student involvement is an indicator of students' interest in learning environments, indicating a complementary interaction between students and school activities (Ainley, 2012). Hence, an increasing number of researchers and educators focus on the concept of student involvement to effectively plan teaching processes and make necessary arrangements in learning environments.

There are different perspectives on the definition and evaluation of the concept of involvement (Sinatra et al., 2015). It has been expressed as a key cognitive tool that connects home, school, and society to students (Reschly & Christenson, 2012). Besides, it is defined as an important indicator of the development and learning process and a unique mental process that can be observed from infancy to adulthood (Laevers, 1993). The educational dimension of this concept is concerned with children's experiences, views, and decisions about their own lives as a whole (Leinonen et al., 2014). Students participating in classroom/school activities explore their own interests and abilities and thus take an active part in the learning process (Laevers,

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2005a). According to Finn ve Zimmer (2012), student involvement can be assessed at all levels of education because it is rooted in the learning process, and assessing student involvement at an early age is necessary to determine the academic failure that may arise in primary school and further levels of education.

Researchers have come up with various classifications regarding involvement, which is a multidimensional concept (Fredricks & McColskey, 2012). The two-dimensional classification consisting of behavioral and emotional dimensions (Finn, 1989; Ryan et al., 1994) expanded over time and evolved into a three-dimensional classification consisting of cognitive, emotional, and behavioral dimensions (Wigfield et al., 2008). Emotional engagement includes having fun in the classroom and having positive experiences in the classroom; cognitive engagement includes the ability to apply knowledge in everyday life and transfer it to the next level of education; and behavioral engagement includes behaviors such as participating in classroom dialogues, completing assigned tasks on time, and complying with school and classroom rules (Wang & Eccles, 2013). Also, behavioral engagement includes active involvement in classroom activities and doing academic tasks that positively affect the learning process (Baker et al., 2008). Listening to the teacher, participating in classroom discussions, and generating new ideas through discussions are related to behavioral engagement (Rimm-Kaufman et al., 2015). The behavioral engagement has been stated to be related to strength, concentration, interest, asking questions, and continuity (Blumenfeld et al., 2005).

Indicators of engagement, which provide important clues in determining students' level of classroom involvement (Laevers, 1993) are how much students concentrate, how much they participate in activities, and to what extent they realize their potential (Laevers & Declercq, 2018). Children with a high level of classroom involvement concentrate fully on the activity, are interested in the process, and are highly motivated. With their body language, gestures, and facial expressions, they show that they are involved in the process and take great pleasure in exploring (Laevers, 2005b). Studies conducted with primary school students have examined behavioral engagement, as it includes involvement in activities that require energy and attention (Lam et al., 2012; Robinson & Lubienski, 2011; Skinner & Pitzer, 2012). The current study focuses on behavioral engagement since it includes determining whether or not children are involved in the learning process and in-class activities based on specific features.

Behavioral engagement relates to students' efforts to participate in educational settings, their involvement in academic activities, and their efforts to complete academic tasks (Suarez-Orozco et al., 2009). Students with a high level of classroom involvement also realize their potential (Laevers, 1993). Primary school students' behaviors in the learning process are stated as academic behaviors (Finn & Zimmer, 2012). It is emphasized that students who exhibit academic behaviors such as paying close attention to classroom activities (Rowe & Rowe, 1992), doing the assigned homework (Cooper et al., 2001), and coming to class prepared are more successful (Finn & Zimmer, 2012). According to Korpershock et al. (2015), encouraging student engagement is necessary for ensuring students' academic achievement. Indeed, students learn more effectively when they participate in classroom activities and build strong relationships with their teachers. Teachers should utilize a variety of strategies to interest non-participating students and to guarantee that participating students continue to participate (Abdullah et al., 2011).

Dimensions such as teacher-student communication, learning environments, and teachers' experience are effective in student involvement (Subramainan & Mahmoud, 2020). Pianta et al. (2012) have emphasized that the positive climate and arrangements in the classroom, the adaptability of the learned knowledge to daily life, and the diversity of teaching methods and techniques have a positive effect on students' involvement levels. In addition, characteristics such as class size, teacher-student ratio, and class seating arrangement have also been found to be effective in classroom involvement (Blatchford, 2003; Helf et al., 2009; Ruble & Robson, 2007). The study conducted by Shernoff et al. (2016) has concluded that the quality of learning environments positively affects students' involvement levels, self-confidence, and academic achievement. It is also stated that apart from the classroom seating arrangement (DiCarlo et al., 2013; Laevers et al., 2012) students' interests in and motivations towards the learning environments (Hartz et al., 2017) and the teacher-student relationship (Dotterer & Lowe, 2011; Papadopoulou & Gregoriadis, 2017; Stroet et al., 2013) affect behavioral engagement. Research has also shown that the materials used in learning environments, technological tools, and teaching methods are effective in student involvement (Graue et al., 2007; Howes et al., 2008; Martin & Rimm Kaufman, 2015).

In the related studies, it has been seen that there is a relationship between the positive and supportive attitudes of teachers and the involvement levels of primary and secondary school students (Allen et al., 2013; Hafen et al., 2012; Marks, 2000). Ryan and Deci (2000) have argued teachers who consider psychological needs such as autonomy and competence support students' involvement levels. Teachers, who offer different activities to their students, support these activities with various teaching materials, and give encouraging feedback to students are more likely to support students' learning and increase their involvement levels (Van den Berghe et al., 2014; Vansteenkiste et al., 2009).

It is necessary to evaluate the level of involvement of students in order to determine the quality of existing programs (Raspa et al., 2001) and to predict students' academic success at later educational levels (Theodotou, 2015). Determining the involvement levels of primary school students is important in terms of determining whether students have achieved the necessary outcomes, evaluating learning processes (Laevers, et al., 2012; Lenaerts et al., 2017), organizing effective learning environments and understanding the cognitive, affective, and behavioral characteristics of students (Booth & Ainscow, 2016). In the literature, it is seen that there are a limited number of studies on determining the involvement levels of primary school students in classroom activities. These studies mostly focus on the associations between primary school students' classroom involvement levels and school climate (Yang et al., 2018), teacher-student interaction (Wang, 2017), students' social-emotional competencies (Papieska, 2019), peer relationships (Cappella et al., 2013) and motivation for engagement in physical education (Martinović et al., 2011).

In Turkey, it is seen that the relationship between primary school students' self-regulation strategies and motivational beliefs (Demircan & Tanrıseven, 2014), parental attitudes and school achievement (Nimsi, 2006), perceived classroom atmosphere (Künkül, 2008) and their level of involvement in classroom activities have been examined. In the research that examined students' involvement levels (Başal, 2001; Demirezen et al., 2016; Sarıtepeci & Yıldız, 2014), measurement instruments that weren't based on observation and were filled out only by students or teachers were used. In order to determine detailed and descriptive comments on students' involvement levels, it is especially important to make observational assessments (Cohen et al., 2011).

Research Focus

In this study, it is thought that evaluating the involvement levels of students with appropriate and objective tools guided the arrangements to be made to improve the involvement levels of primary school students.

Research Aim and Research Questions

This study aimed to examine the involvement levels of primary school first, second, third, and fourth-grade students in Turkey in terms of different variables. Evaluating involvement, which is an important indicator of academic achievement and the learning process, with objective tools and examining the involvement and levels of students in terms of different variables contributed to the determination of the factors affecting the level of involvement and the arrangements to be made to increase the level of involvement.

Answers to the following questions were sought within the scope of the study:

- What is the level involvement of primary school 1st, 2nd, 3rd, and 4th grade students in classroom activities?
- How do the variables (gender, grade, course, and professional experience) influence the participants' involvement?

Research Methodology

Research Design

Studies in which students' understanding of a particular concept, attitudes, beliefs, and skills are examined according to their grade levels are defined as cross-age studies (Abraham et al., 1994; Ruane, 2005). Cross-age studies are especially preferred in terms of efficient time and practicality (Krnel et al., 2003). In the literature, it is seen that cross-age studies have been conducted to examine students' understanding of certain concepts at different levels such as secondary school (Ayas et al., 2010; Uzun et al., 2013), high school (Calik, 2005; Trumper, 2001) and undergraduate (Çalik et al., 2014; Karatas et al., 2011). A cross-age study was used in this research in which the involvement levels of primary school students in terms of different variables were examined.

Sample

The population of the research consisted of students attending primary schools affiliated with the Ministry of National Education, located in a city center in the inner Aegean region of Turkey, in the 2019-2020 academic year. The study sample was selected from an accessible population using a random sampling method. A list of primary schools was obtained from the Provincial Directorate of National Education, and random selection was made from low, middle, and high-level primary schools representing all three levels (Baştürk & Taştepe, 2013).

Based on the data obtained from the Provincial Directorate of National Education, the accessible population consisted of 41 schools and approximately 3,800 first, second, third, and fourth graders. The sample of the research included a total of 560 first, second, third, and fourth graders attending 14 primary schools affiliated with the Ministry of National Education, located in a city center in the inner Aegean region of Turkey. The sample size to be reached in the research was calculated with a margin of error of $\alpha = 0.05$ and it was determined that a sample group of at least 250 people should be reached (Büyüköztürk et al., 2017).

Of the students, 50.4% are girls, 49.6% are boys, 25% are first graders, 25% are second graders, 25% are third graders, and 25% are fourth graders. On the other hand, of the teachers included in the research, 52.1% are female, and 47.9% are male. Also, 23.9% of the teachers have teaching experience of 9-15 years, 28.2% 16-20 years, 19.7% 21-29 years, and 28.2% 30-40.

Instrument

To collect data about the students, parents, and classroom teachers participating in the study, a personal information form was developed by the researchers. The personal information form includes questions about students' gender, age, date of birth, class, teachers' gender, age, teaching experience, and department from which they graduated.

The Leuven Involvement Scale used in this research was developed by Laevers et al. (2010) to determine student involvement levels. This scale is an observation-based scale that rates student involvement levels from 1 (very low) to 5 (very high). If a student puts no mental effort into, shows no interest in, or pays no attention to any classroom activity, then their involvement level is rated as very low. If a student is distracted very often during classroom activities, then their involvement level is rated as low. If a student is partially interested in classroom activities, does not insist on completing them, or has a short attention span, then their involvement level is rated as moderate. On the other hand, if a student is not easily distracted throughout activities and is highly motivated to complete them, then their involvement level is rated as high. Finally, if a student gives full attention to classroom activities, is not distracted despite external distractions, has fun when doing activities, and does everything that the activity requires, then their involvement level is rated as very high (Laevers, 2017).

The scale consists of a total of two parts: involvement levels and the indicators to be considered about the involvement levels. Indicators to consider when determining student involvement are concentration, energy, complexity and creativity, facial expression and posture, persistence/tenacity, attention, reaction time, words, and satisfaction. These indicators provide important clues when determining classroom involvement levels. The scale does not score these indicators (Laevers et al., 2010). For instance, the concentration indicator example is described as follows: The child focuses his or her attention on the activity being performed. The child's attention is only diverted when confronted with strong stimuli. The energy indicator is as follows: Physical energy should be considered during physical activities. Sweating can also be considered when identifying involvement levels. Loud talking (shouting) and short-term actions can be considered physical elements in other activities. This is not to be confused with the expression of suppressed energy.

Reliability studies conducted for primary school students found inter-observer agreement coefficients to be between .61 and .91 (Boonen et al., 2013; Lietaert et al., 2015). The validity and reliability of the Turkish version of the Leuven Involvement Scale was carried out by Erdem (2021). To determine the content validity of the scale, the content validity ratio (CVR) of each item was calculated in the evaluation of the opinions of seven experts. Then, the content validity index (CVI) was determined by averaging the calculated CVIs (Lissizt & Samuelsen, 2007). The index value was calculated as 1.00 and it was determined that all items in the scale were necessary and content validity was achieved (Lawshe, 1975). Within the scope of the reliability study, the scale was administered to 100 students attending the primary schools included in the research permit together with the co-observer. The observers were present in the observation class at the same time and observed the students during the in-class activities carried out during the lesson hours simultaneously. The researcher and the co-observer observed each student three times at two-minute intervals. The inter-observer agreement was calculated with the Cohen Kappa coefficient (Kılıç, 2015). Inter-observer agreement coefficients were determined as ($\kappa = 0.991$, $p < .05$); in the first observations, ($\kappa = 0.994$, $p < .05$) in the second observations, and ($\kappa = 0.996$, $p < .05$); in the third observations, and it was concluded that the inter-observer agreement coefficients were perfect in all observations.

Procedures

Prior to the data collection process, ethics committee permission (25.09.2019/2019-88) and research permission were obtained from the Provincial Directorate of National Education. An informed consent form was distributed to the parents of the students, and the scale was applied to the children of the parents who agreed to participate in the study.

The scale is an observation-based measurement tool, and observations to determine the student involvement levels need to be carried out at intervals (Laevers, 2017). During the observations, evaluations based on the characteristics to be considered regarding student involvement are recorded in the observation form. Primary school students' involvement levels in classroom activities are determined by observations made at three different intervals (lesson/activity) (Papieska, 2019).

Before starting the observations, appointments were made with the schools from which permission was obtained and school principals were informed about the purpose and stages of the research. The classes to be observed were determined together with the principals and teachers who volunteered to participate in the study. Then, the teachers of the determined classes were interviewed, the necessary information about the research process was given, and the days and lesson hours to be observed were planned together. A voluntary consent form was sent to the parents, and the scale was applied to the children of the parents who completed the consent form. The researcher observed each student in the sample during classroom activities. Observations were made during the following classes: Turkish, Math, Social Studies, Science, Visual Arts, Music, Physical Education and Games, Leisure Activities, Religious Culture and Morals, English, Human Rights and Citizenship, and Life Studies. Each student was observed three times at two-minute intervals, and observation notes were recorded on scale forms for each student. A total of 560 students were observed for a total of 1680 times, and these observations took approximately 16800 minutes during a total of 420 lesson hours.

Data Analysis

The data collected through the scale and personal information form were evaluated with appropriate statistical methods. The data were analyzed using the SPSS 20 package program. Descriptive statistics such as percentages and frequencies were used to evaluate the demographic characteristics of students and teachers. A (K-S) normality test was conducted to determine whether the students' scores from the Leuven Involvement Scale (2010) were normally distributed.

During the data analysis, descriptive statistics such as frequency and percentage were used to evaluate the demographic characteristics of the participants. A (K-S) normality test was conducted to determine whether the students' scores from the Leuven Involvement Scale (2010) were normally distributed. Because the scores were not normally distributed, the Mann-Whitney U test was used in two independent groups and the Kruskal Wallis-H test in more than two independent groups. The level of significance was set at .05, with $p < .05$ indicating a significant difference (Büyüköztürk et al., 2017).

Research Results

The results of the analysis of the student involvement levels are presented in the tables below.

Table 1
Students' Mean Scores

Grade	*N*	$\bar{x}$	*Md*	*Min.*	*Max.*	*SD*
First	140	3.13	3	1	5	1.162
Second	140	3.06	3	1	5	.950
Third	140	3.12	3	1	5	.804
Fourth	140	3.04	3.0	1	5	.955
Total	560	3.09	3.0	1	5	.976

***N:** Number of students **$\bar{x}$:** Mean *Md*: Median Min.: Minimum Max.: Maximum *SD*: Standard Deviation

As can be inferred from Table 1, first graders have a mean observation score of 3.13, second graders 3.06, third graders 3.12, and fourth graders 3.04. This indicates that all the grades have moderate involvement levels.

Table 2
Mann-Whitney U Test Results by Gender

Gender	*N*	$\bar{x}$	*Md*	*Min.*	*Max.*	*SD*	*Mean Rank*	Mann-Whitney *U* test *U*	 *p*
Girl	278	2.99	3	1	5	1.008	796.6	316	.0001
Boy	282	3.18	3	1	5	.935	883.8		
Total	560	3.09	3	1	5	.976			

N:* Number of students **$\bar{x}$: Mean *Md*: Median Min.: Minimum Max.: Maximum *SD*: Standard deviation

U: Mann–Whitney *U* statistic

As can be inferred from Table 2, there is a significant difference between male and female students' mean scores: female students have significantly higher involvement levels than male students. On the other hand, both male and female students have moderate involvement levels. Based on these findings, it can be argued that the gender variable is effective in students' involvement levels.

Table 3
Kruskal-Wallis H Test Results by Grade

Grade	Kruskal-Wallis *H* test								
	N	$\bar{x}$	***Md***	***Min.***	***Max.***	***SD***	***Mean Rank***	***H***	***p***
First	140	3.13	3	1	5	1.162	855.9	.739	.864
Second	140	3.06	3	1	5	.950	833.9		
Third	140	3.12	3	1	5	.804	840.2		
Fourth	140	3.04	3	1	5	.955	831.9		
Total	560	3.09	3	1	5	.976			

**N:* Number of students $\bar{x}$: Mean *Md*: Median Min.: Minimum Max.: Maximum *SD*: Standard deviation

H: Kruskal-Wallis H statistic

As can be inferred from Table 3, there is not a significant difference among grades in terms of mean scores from the Leuven Involvement Scale. Based on these findings, it can be argued that the grade variable is not effective in student involvement.

Table 4
Kruskal-Wallis H Test Results by Course

Course	Kruskal-Wallis *H* test									
	N	$\bar{x}$	***Md***	***Min.***	***Max.***	***SD***	**Mean Rank**	***H***	***p***	**Paired comparison**
Maths	460	3.16	3	1	5	.93	859.7	114.2	.0001	1-4 1-6 2-4 2-6 2-7 3-1 3-4 3-6 3-7 5-4 5-6 5-7 9-4 9-6 9-7 12-1 12-4 12-6 12-7
Turkish	410	2.96	3	1	5	.98	779.9			
Science	140	2.82	3	1	4	.75	674.2			
Visual Arts	140	3.48	4	1	5	.92	1037.4			
Life Studies	100	2.86	3	1	5	.91	717.9			
Music	100	3.41	4	1	4	.90	1039			
Physical Education and Games	100	3.34	4	1	5	1.208	1009.9			
Free Activities	100	3.10	3	1	5	1.078	844			
English	50	2.92	3	1	4	.82	738			
Human Rights, Citizenship and Democracy	30	2.97	3	1	4	1.129	830.3			
Social Studies	30	3.17	3	1	5	.83	851.5			
Religious Culture and Morals	20	2.20	2	1	4	.95	438			
Total	1680	3.09	3	1	5	.97				

**N*: Number of observations $\bar{x}$: Mean *Md*: Median Min.: Minimum Max.: Maximum *SD*: Standard deviation

H: Kruskal-Wallis H statistic

Since the course type, program, and hours varied in each class, the number of observations also varied. It was found that students had significantly lower involvement levels in Math classes than in Visual Arts and Music classes, and also in Turkish classes than in Visual Arts, Music, and Physical Education and Games classes. On the other hand, students had significantly lower involvement levels in Science classes than in Math, Visual Arts, Music, and Physical Education and Games classes, and also in Life Studies classes than in Visual Arts, Music, and Physical Education and Games classes. Finally, they had significantly lower involvement levels in English classes than in Visual Arts, Music, and Physical Education and Games classes, and also in Religious Culture and Morals classes than in Math, Visual Arts, Music, and Physical Education and Games classes.

Table 5
Kruskal-Wallis H Test Results by Teachers’ Professional Experience

Experience								Kruskal-Wallis *H* test		
	N	$\bar{x}$	***Md***	***Min.***	***Max.***	***SD***	**Mean Rank**	***H***	***p***	**Paired comparison**
9-15	11	2.94	3	1	5	1.03	773	8.6	.035	1-2 1-3 1-4
16-20	3	3.19	3	1	5	.77	875.4			
21-29	35	3.12	3	1	5	1	853.3			
30-40	7	3.09	3	1	4	.93	850.4			
Total	56	3.09	3	1	5	.98				

**N*: Year of the experience $\bar{x}$: Mean *Md*: Median Min.: Minimum Max.: Maximum *SD*: Standard deviation
H: Kruskal-Wallis *H* statistic

As can be inferred from the table, there is a significant difference among teachers’ professional experience in terms of mean Leuven Involvement Scale scores: it was seen that the students of teachers with experience of 9-15 years had significantly lower involvement levels than those of teachers with experience of 15 years or more. Based on this finding, it can be argued that teachers’ professional experience is effective in students’ involvement levels.

Discussion

As a result of this research aiming to determine the involvement levels of primary school students in classroom activities, it was determined that students in Turkish primary schools had a moderate level of involvement. This result indicated that primary school students’ attention and concentration in classroom activities were limited and their time to continue the given task/activity was limited. Based on this, it can be said that necessary changes should be made in learning environments and processes to improve students’ involvement levels, which is an important determinant of academic success (Bierman et al., 2009; Li et al., 2010), an important indicator of the quality of the teaching process and learning objectives (Goldspink & Foster, 2013; Raspa et al., 2001). Similar to this result, Laevers (2017) examined the level of involvement and emotional well-being of primary school students in Belgium and concluded that the level of involvement of students was at a moderate and improvable level. Similarly, Goldspink (2008) stated that involvement was an indicator of the quality of the learning environment, and as the level of involvement increased, the quality of the learning environment would increase, and all these would affect academic achievement. In parallel with this idea, Schnitzler et al. (2020) determined that students with high academic achievement exhibited moderate and high levels of involvement in the classroom.

In this study, when the involvement levels of students according to gender variable were analyzed, it was determined that female students showed higher involvement in classroom activities than male students. This situation can be explained by the fact that the activities carried out at school appeal to female students who have better interest and motivation towards reading due to their characteristic features, and that the content in which male students can be more active and visual processes are used more frequently are not included (Geist & King, 2008). In this research, this gender difference observed in terms of primary school student's involvement in classroom activities is also observed at different levels of education. Martin (2004) stated that female students' ability to involve in an activity, focus and adaptation skills are higher than male students. In the study conducted by Kayabaşı et al. (2019), it was concluded that female students participated in the lesson more than male students. Similarly, Finn et al. (1991) determined that the involvement of primary school 4th-grade female students was higher than male students in their study. In studies examining the involvement levels of students at different levels of education, it was concluded that female students had higher involvement levels than male students (Baroody & Diamond, 2013; Vansteenkiste et al., 2012). Unlike these results, there are also studies that found that gender variable was not effective in the involvement levels of preschool children (Akyol, 2020; Theodotou, 2015). Examining the level of involvement, which is related to the level at which students realize their potential in terms of gender, cognitive and emotional dimensions, will offer different perspectives.

It was found in this study that there was no significant difference between the students' grade levels and their involvement levels. The result that the involvement levels of the students at all levels of primary school students determined in this research are at a medium level reveals different perspectives in terms of developmental and curriculum development. From a developmental perspective, it is important to evaluate the participation levels of students, which are an indicator of their interests and abilities and show individual differences, both individually and as a group (Laevers & Declercq, 2011). When students use their abilities to the maximum, they make progress in all areas of development. In the study conducted by Skinner et al. (2008), it was determined that there was a significant reduction in students' involvement from kindergarten to the end of high school, including their interest in learning and motivation. More effective learning methods and strategies will be developed and used more frequently in schools, increasing student involvement (Yalçınkaya & Tonbul, 2002). Considering that the level of involvement is an important predictor of academic achievement at later education levels (Schnitzler et al. 2020; Taylor & Nelms, 2006) and an important criterion in preventing school dropout levels (Stichter & Lewis, 2006), it suggests that necessary arrangements should be made to increase the involvement levels of primary school students. It is emphasized that the learning support (Sabol, et al., 2018) that teachers provide to students during student-centered activities that they plan by providing a variety of materials and options (Gülcü & Golezani, 2020; Roskos et al., 2012; Vansteenkiste et al., 2012) is critical in increasing their level of involvement.

In the current study, it was concluded that the involvement levels of primary school students differed according to the course type. It was determined that the involvement levels of the students in Math, Turkish, Science, English, Religious Culture and Moral, Visual Arts, Music, Physical Education and Games courses were lower than the involvement levels in these courses. It is thought that the anxiety levels of the students about these courses and the teacher, the teachers' use of traditional methods in the lessons, the characteristics of the teachers and the fact that they teach the lessons without taking into account the individual differences of the students may have caused low involvement levels in the students. At the same time, it was seen that the level of student involvement in Visual Arts, Music, Physical Education, and Games courses was higher than in other courses. It can be said that the use of more active, student-centered methods in these courses is effective. Similar to this result, Mark (2000) found that the involvement levels of students at primary, secondary and high school levels differed in mathematics or social studies courses. In the study conducted by Martiniovic et al., 2011 it was concluded that boys' participation in sports and motivation for physical education were higher than girls in primary school. In the literature, it has been concluded that the interaction with their teachers (Işık & Arslan, 2020), the flipped classroom model (Fulton, 2012; Kaya, 2018; Muir, 2017) and the 5E instructional model (Gülcü & Golezani, 2020) used by teachers, the teaching based on the theory of multiple intelligences in the science and technology course (Atik, 2010) positively affect students’ involvement in the lessons, especially in the mathematics course where students have the most difficulties and their involvement levels are low.

All kinds of activities in the classroom constitute the objective of education. While ensuring student involvement in classroom activities, it is necessary to create a positive classroom atmosphere without discouraging them (Künkül, 2008). Classroom activities where students feel more comfortable and successful can ensure a higher level of student engagement. For this reason, it is important for teachers to plan classroom activities by taking into account the characteristics and interests of students in lessons where student involvement is low. Anderson (2016) stated that in project-based learning, students will make choices by experiencing individually, their apathy towards the lesson will decrease, and they will gain motivation. Carrabba and Farmer (2018) concluded in their study that when students are educated in a project-based learning environment, student motivation and involvement increase. Similarly, studies have shown that students studying in constructivist learning environments participate more actively in behavioral, emotional, and cognitive aspects (Kalem & Fer, 2003; Kurt & Bayar, 2020; Zhang, 2008). Davidovitch and Yavich (2023) emphasized the importance of increasing students' involvement and motivation in digital learning environments. In studies evaluating students’ involvement in terms of peer relations, it was observed that students had higher levels of involvement in classes where students made their own choices about learning, worked in groups with their friends (Robinson, 2013) and in classes where student interactions were intense (Cappella et al., 2013).

Another result obtained is that teachers’ professional experience is effective on the involvement levels of primary school students. The fact that the involvement level of the students in the classes of teachers with more seniority is higher may be due to the experience brought by seniority. It can be thought that the professional experience can positively affect the dimensions such as organization of the learning environment, teacher-student interaction, and teaching methods which are effective on students’ involvement. Professional experience improves teachers’ awareness of the factors affecting teaching and enables them to integrate theory and practice (Taggart & Wilson, 2005). In the literature, there are studies that concluded that as teachers’ seniority increases, their classroom management skills (Dinçer & Akgün, 2015), professionalism (Zembat & *İçli* Küsmüş, 2020), and professional values (Bakioğlu & Koç, 2017) also increase.

It is stated that teacher-student interaction regarding teachers’ classroom management skills also affects involvement (Fredricks et al., 2004). There are studies that concluded that there is a relationship between a positive teacher-student relationship and a high involvement level of students (Dotterer & Lowe, 2011) and a negative relationship and a low involvement level (Sabol, Bohlmann, & Downer, 2018). Çelik et al. (2018), as a result of their study, determined that students are more successful in the lessons of the teachers they like, and their behavioral engagement increases as their success increases. Gündüz and *Özarslan* (2017) found that teachers with higher seniority behaved more understanding and mature towards students’ adaptation problems. Cıvabaş (2019) found that teachers’ leadership, helpful and understanding behaviors increased student engagement, while their ambiguous, admonishing and strict behaviors negatively affected student engagement. *Çobanoğlu* ve Demir (2022) found that educators’ justice in classroom management is associated with students' school engagement. It is seen that the results obtained from all these studies support the findings of the current study.

Conclusions and Implications

As a result of this research, it was determined that students in the first, second, third and fourth grades of primary schools in Turkey have a moderate level of involvement. It was concluded that there was a significant difference between the involvement levels of primary school students and the gender, course type, and seniority of the teacher, but there was no significant difference between the grade levels of the students.

Based on the results obtained in this study, the following recommendations can be made: To increase the involvement levels of primary school students from medium to high levels, teachers should revise their lesson plans in line with the indicators and dimensions of involvement. Current methods and techniques should be used to increase students’ involvement in classroom activities in different courses and arrangements should be made to improve involvement in the learning environment. In-service training can be organized for classroom teachers on observation-based assessment tools for determining students’ involvement levels in the classroom. Considering that it is important to determine the involvement levels of primary school students with objective assessment tools, the involvement levels of students can be evaluated comprehensively with different measurement tools such as teacher interview forms and family interview forms developed by the researchers together with the Leuven Involvement Scale. International comparative studies can be planned to examine the involvement levels of primary school students.

The limitations of this research, which aims to determine the involvement levels of primary school students in classroom activities in Turkey, are that it was determined only by the observations made by the researchers. In addition, one of the limitations is the variation in the number of observations due to the differences in the type of courses, hours, and programs at each grade. The addition of teacher evaluations and teacher-student interviews together with observations may provide more generalizable results. In this study, only the behavioral dimension of engagement was addressed. More comprehensive studies can be planned by addressing the cognitive and emotional dimensions of engagement.

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Declaration of Interest

The authors declare no competing interest.

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THE EFFECT OF MACROSTRUCTURE AND SUPERSTRUCTURE TEACHING ON SUMMARIZATION ACHIEVEMENT

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Abstract

Selecting and remembering the necessary information from rapidly increasing information requires summarization skills. Research on improving students' summarization skills has focused on deletion, generalization, and reconstruction strategies. However, direct teaching of these strategies does not yield successful results. For this reason, researchers have turned to teaching summarization based on understanding the text. Knowing the macrostructure and superstructure of the text can help understand the text and select the information to be included in the summary. The aim of this study is to determine the effect of macrostructure and superstructure teaching on summary writing achievement. The study was conducted in a one-group pretest-posttest design and lasted for 6 weeks. The study was conducted with 22 seventh grade students in a public secondary school. The data were collected with a total of 132 summary texts in which students summarized five stories. The summaries of texts were scored with the Text Summary Evaluation Rubric (TSER). As a result of the study, significant differences were obtained in summarization achievement in favor of the posttest. Based on this result, it is recommended that macrostructure and superstructure teaching be included in programs and course books. This study is limited to narrative texts. In future studies, whether the achievement in summarization narrative and informative texts differs and how long it takes for different age groups to develop their achievement in summarization of different types of texts can be examined based on text structure teaching.

Keywords: *Macrostructure teaching, superstructure teaching, summarization achievement, seventh grade students*

Introduction

Innovations in the world of information and technology and the ability to spread information across the world in seconds have made it easier to access information. However, understanding the information presented, selecting the important ones, and remembering them when necessary have become important skills in order to benefit from the rapidly increasing accumulation of knowledge. An effective way of developing these skills is teaching summarization. Summarization is the "reductive transformation of the source text into a summary text by condensing the content through selection and/or generalization about what is important in the source." (Sparck Jones, 2007, p. 6). Summarization is a multi-layered skill that involves both comprehension and expression skills. For this reason, it should not be considered as a skill that students can acquire without training.

While teaching summarization, students should be explained what they should do before, during and after summarization and guidance should be provided to support their learning. The basic stages of summarization are comprehending the text, selecting or creating important information, shortening the text without losing the main message, and writing fluently in their own words. In this respect, summarization is primarily based on reading comprehension. There is a reciprocal relationship between summarization and reading comprehension. Good

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readers write good summaries (Bahap Kudret & Baydık, 2016; Pirc & Pecjak, 2018), teaching summarization strategies increases reading comprehension (Belet, 2005; Dollins, 2012; Graham & Hebert 2010; Khathayut & Karavi, 2011; Khoshsima & Rezaeian Tiyar, 2014; Nelson, Simith & Dodd, 1992; Nurhayati & Fitriana, 2018; Pakzadian & Rasekh, 2012; Sucita & Hukom, 2022). Bahap Kudret and Baydık (2016) found a positive, moderate relationship between reading and summarization achievement. However, reading comprehension and understanding the text for summarization are not the same. Writing summaries is not a natural consequence of understanding and remembering the text; it is necessary to use deliberate processing strategies for summarization as well as comprehension (Hidi & Anderson, 1986). The process of selecting particularly important propositions and reducing them, in which propositions are deliberately condensed through various higher-order transformations, is a key feature of reading for summarization (Winograd, 1984 as cited in Hidi & Anderson, 1986).

In the process of teaching summarization, first of all, analyzing good and bad summaries and starting with the completion of incomplete summary texts will provide a concrete view of what can be included in the summary (Blanchard & Root, 2004). After the summary structure is introduced, summarization strategies can be taught. The deletion, generalization, selection and construction strategies developed by Kintsch and van Dijk (1978) are frequently used in teaching summarization strategies. According to Kintsch and van Dijk (1978), summarization is the technique of creating the macrostructure of the text by identifying its important points. The macrostructure is a structure that preserves the general meaning and structure of the original text but is stripped of details. According to this model, each sentence that forms the basis of the text and the relationship between sentences constitutes the microstructure. Deletion, generalization, and construction operations are applied to create a macrostructure from a microstructure. In the deletion process, a sentence is deleted if it is insufficient to represent the whole and creates a coincidental connection with other sentences. In generalization, similar concepts related to the same concept area in the text are generalized. In structuring, the propositions in the text are evaluated and transferred to a new set of propositions.

Deletion, generalization, and construction are the ultimate goals of summarization. However, research shows that teaching summarization based only on these strategies does not produce very successful results. Students have difficulty in selecting important information (Özçakmak, 2015; Friend, 2001), deleting unimportant information (Garner, 1982) or construction (Kim, 2001). In the experimental study conducted by Aydın (2022), secondary school students were taught deletion, generalization, and construction strategies. As a result of the study, it was determined that students did not show improvement in any of these strategies. Rather than teaching "deletion, generalization and reconstruction" strategies directly, the researchers focused on text comprehension studies for summarization. In summarization teaching, it is tried to improve the ability to select important information by using text-oriented questions (Boğa, 2019), mind maps (Aksoy, 2022; Aulia, 2017), story maps (Arslan, 2017; Şahin, 2012) or thinking about the text, associating ideas with each other (Friend, 2001). The common feature of these studies is content-based summarization. Content-based summarization is a summarization technique based on the main content of the text (Cahyono, 1996). This “summarization technique is able to improve student’s comprehension and their summaries skill especially in cases of finding the main ideas, committing plagiarism and committing distortion” (Khathayut & Karavi, 2011, p. 7).

The results obtained from the literature review have shown that it is important to develop comprehension for summarization purposes in summarization teaching. In order to achieve this, this study adopted a summarization teaching process supported by the teaching of strategies for identifying the macrostructure and superstructure that make up the text. The macrostructure is a structure that takes the text as a whole, reflects the general meaning of the text and constitutes the content of the text. Without creating the macrostructure of the text, it is impossible to make semantic organization by eliminating complex information and to perceive the general meaning of the text (van Dijk & Kintsch, 1983). Working on macrostructure is important for both understanding the text and determining the elements to be summarized. This is because in macrostructure, the main topic is the most basic structure, and determining the main topic of a text and the subtopics that lead to this topic is essential for understanding the text. The elements of macrostructure that ensure the coherence of the text in terms of its topic include the title, topic sentence, keywords, main and auxiliary thoughts/events, content schema, topic change determinants and a conclusion sentence.

The type of text determines which information should be included in the summary text (Dilidüzgün, 2013, p. 51). For this reason, it is important to conduct summarization teaching based on text types. The genre-specific structuring of the text is the superstructure of the text. The superstructure of narratives consists of "setting, initiating event, internal response, attempt, consequence, and reaction" (Stein & Glenn, 1979 as cited in Chen & Su, 2012, p. 186). The setting element includes time and place; initiating the event is the main problem, attempt is the main character's first reaction to the main problem, consequence is whether the main character solves the problem or not, and the reaction is the main character's response to the consequence (Chen & Su, 2012). All of these elements should be included in the summary of a narrative text. Recognizing the genre-specific structure of narrative texts is useful for determining what should be included in the summary.

The next stage in summarization teaching is writing the summary. At this stage, writing skills come into play. Writing an original text is based on planning the basic ideas and details, but summary writing is based on comprehension, evaluating, condensing, and transforming the original text (Hidi & Anderson, 1986). When writing a summary, it is possible to sort the selected or created sentences according to the subject/event order, to make them into a coherent whole by using transitional link expressions, to write with one's own sentences, to put a new title, to ensure time coherence and to check the consistency between the summary and the source text.

Teaching summarization is a part of foreign language teaching and mother tongue education. In the Turkish Language Teaching Programme, summarization is included both as a reading and writing strategy and as a learning outcome. However, deletion, generalization and construction strategies are not included in the curriculum and course books. Students are asked to write a summary within the framework of the instruction "summarize the text" in the course books. However, students are not shown how to do this, and they are not given regular feedback on their summaries (Aydın, 2022). Students' receiving feedback is an important factor in the development of summarization skills (Özdemir, 2018). As a result of the lack of regular teaching, summarization problems are seen at all levels from primary school to university. Students fail to distinguish important information from unimportant information (Aktaş & Bayram, 2017; Aydın, 2022; Bahap Kudret & Baydık, 2016; Erdem, 2012; Karatay & Okur, 2012; Özçakmak, 2015), frequently include quotations in their summaries (Çıkrıkçı, 2008), and do not use the tense of expression correctly (Sulak & Arslan, 2017). It is possible to transform unsuccessful summaries into ideal summaries by teaching summarization strategies. There are many studies confirming this claim (e.g. Aksoy, 2022; Anderson & Hidi, 1989; Arslan, 2017; Aulia, 2017; Boğa, 2019; Cahyono, 1996; Friend, 2001; Özdemir, 2018).

Experimental studies on teaching summarization strategies are generally conducted with university students and are generally aimed at summarization informative texts in a foreign language (e.g. Aulia, 2017; Bahrami & Rahimy, 2022; Febriani et al., 2019; Friend, 2001; Khathayut & Karavi, 2011; Kim, 2001; Li, 2016). It is seen that experimental studies on the summarization of informative texts in the mother tongue were conducted at the primary school level (Armbruster et al., 1987; Arslan, 2017; Özdil, 2019; Westby et al., 2010) and secondary school level (Aydın, 2022; Çıkrıkçı, 2008). Summarization teaching based on narrative text structure teaching was conducted with primary school students (Hellmann & Ehri, 2020) and university students (Chen & Su, 2012). There is no experimental study focusing on both the macrostructure and the superstructure of narrative texts conducted in the mother tongue and with secondary school students. The study is important because it will fill this gap in the literature.

Research Problem

Identifying the elements that make up the macrostructure of the text can be a way of distinguishing important information from unimportant information in summarization. Macrostructure elements are presented in an order specific to the text type, that is, according to the superstructure of the text. Macrostructure and superstructure information can be guiding in determining what to include in the summary. In the literature review, it is seen that no summarization study has been conducted to teach strategies for these two structures together. Knowing these structures may reduce the problems encountered in summarization.

Research Focus

The focus of the research is to determine how knowing the macrostructure and superstructure of narrative texts affects secondary school students' summarization achievement.

Research Aim and Research Questions

This research aims to examine the effect of summarization teaching supported by teaching macrostructure and superstructure determination strategies on the development of secondary school students' achievement in summarization narrative texts. The subject was addressed with two research questions:

1. How is the weekly development of secondary school students' achievement in summarization narrative texts after summarization teaching supported macrostructure and superstructure identification strategies?

2. What is the effect of teaching macrostructure and superstructure on summarization narrative texts achievement?

Research Methodology

Research Design

The research was conducted with one group pretest-posttest model which is one of the one group pre-test post-test designs. In this design, an independent variable is applied to a group. Measurements are made before and after the treatment. If the posttest scores are greater than the pretest scores, it is accepted to be from the independent variable (Karasar, 2009). The experimental process of the research lasted 6 weeks in the spring term of the 2021-2022 academic year. The study was conducted for 2 lesson hours per week. In the first week, pretest data were taken, and no training was given. In the second week, the process of teaching summarization strategies was started, and in the third and subsequent weeks, studies were continued for the strategies in which the students did not show improvement. The experimental process was completed when the summarization achievement exceeded the average in all criteria. The experimental process is explained in detail below.

Study Group

The study group of the research consists of 7th-grade students studying in a public school. The experimental process was carried out with students taking the "Authorship and Writing Education" course in the spring term of the 2021-2022 academic year. The class size was 30, but the study was completed with 22 students due to 6 students who were absent some weeks and 2 students who did not want to participate in the study. 13 boys and 9 girls, a total of 22 students participated in the study voluntarily. Approval for the research was received from Bartin University Social and Human Sciences Ethics Committee. The ethics committee approval number is 2022-SBB-0034.

Data Collection Tools

The data of the study were collected with a total of 132 summary texts in which students summarized 5 stories. In determining the texts to be summarized, 10 stories suitable for the level of secondary school students, with easy and medium difficulty levels of readability were determined by the researchers. The determined stories were presented to two Turkish language teaching experts. The experts analyzed the texts in terms of the criteria of having clear macrostructure and superstructure features and being suitable for the level of students. The 5 narrative texts that both experts found appropriate according to all criteria were used in the study. The medium difficulty story named Kırmızı Pabuçlar (Red Shoes) was used in the pretest and posttest. Information about the summarized stories is presented in Table 1 in the order of weekly study.

Table 1
Information about the Summarized Stories

Week	Text	Number of Words	Author	Readability Level
1	Kırmızı Pabuçlar (Red Shoes) (Pretest)	605	Nehir Tunaz	Moderate
2	Kaynatılmış Tohum (Boiled Seed)	752	Murat Ertan	Easy
3	Portakal (Orange)	813	Mustafa Çiftçi	Easy
4	Kaşağı (Grooming Brush)	698	Ömer Seyfettin	Easy
5	Son Kuşlar (Last Birds)	576	S. Faik Abasıyanık	Moderate
6	Kırmızı Pabuçlar (Red Shoes) (Posttest)	605	Nehir Tunaz	Moderate

Text Summary Evaluation Rubric

The summaries of the above texts were scored with the Text Summary Evaluation Rubric (TSER). The scores obtained were used as the achievement score for the summarization of narrative texts. The rubric was developed by Benzer et al., (2016). The rubric includes 12 criteria related to "form, content and style" dimensions. The criterion of "side thoughts/events" in the content criteria of the rubric was excluded from the analysis because it covers the criterion of "plot". The criterion of "writing a new title", which is directly related to the content of summary texts, was added. The rubric is presented in Table 2.

Table 2
Text Summary Evaluation Rubric

Theme	Criteria	Inadequate (1p.)	Need to Improve (2p.)	Successful (3p.)
SHAPE	1. Paper order	Paper order is not respected.	Paper order is not respected partially.	Paper order is sufficient and placed in the center.
	2. Paragraph number	Summary text consists of 7 or more paragraphs.	Summary text consists of 4-6 paragraphs.	Summary text consists of 1-3 paragraphs.
	3. Grammar, punctuation, spelling	6 and more grammar, punctuation, and spelling mistakes have been made.	3-5 Grammar, punctuation, and spelling mistakes have been made.	1-2 Grammar, punctuation, and spelling mistakes have been made.
CONTENT	4. Writing a new title	The title is not written.	The title of the source text is written verbatim.	A new title has been added to the summary.
	5. Content integrity	Content integrity is not respected.	Content integrity is not respected partially.	Content integrity is satisfied.
	6. Introduction sentence	There is no introduction sentence.	Introduction sentence is inadequate.	The introduction sentence gives the topic of the text.
	7. Plot	In summary, topic and event order are not paid attention to.	In summary, the topic and event order were messed up.	In summary, the topic and event order are given in the correct way.
	8. Details	Unnecessary details and unrelated information to the topic are written.	Unnecessary details and unrelated information to the topic are given less.	Details and unrelated information with the topic aren't given.
	9. Use of keywords	Keywords have not been mentioned.	Some of the keywords have not been mentioned.	All keywords have been mentioned.
	10. Main idea	The main idea has not been issued.	The main idea has been issued partially.	The main idea has been determined.
STYLE	11. Use of time suffixes	Time suffixes have been used as incompatible.	Some of the time suffixes have been used as incompatible.	Time suffixes have been used as compatible.
	12. Direct citation or imitation	It consists of direct citation or imitations from the main text.	It consists of fewer sentences, which makes direct citations or imitations from the main text.	It is written with the expression of the reader.

Procedure

Week 1: No training on summarization strategies was applied. Students summarized the Kırmızı Pabuçlar (Red Shoes) text based on their existing knowledge. These summaries were used as a pretest of summarization achievement.

Week 2: Narrative text superstructure was introduced. Information was given about the macro scale structure elements such as topic sentence, main idea sentence, title, keywords, topic change determinants, conclusion sentence and content scheme. These were exemplified in a story they had previously studied in the textbook. Deletion, generalization, and construction strategies were introduced, and a sample study was carried out on the same story. Based on the criteria in the rubric, a summary text structure was introduced. Successful and unsuccessful examples were selected from the summaries of the first week and shown on the smart board and the reasons why these examples were successful or unsuccessful were discussed. Then, the evaluations of the previous week's summaries with the rubric were given to the students. Finally, the students summarized the story of Kaynatılmış Tohum (Boiled Seed) within the framework of the information they learned.

Week 3: The detailed evaluation of the Kaynatılmış Tohum text with the rubric was distributed to the students to see their mistakes. In addition, successful, average and unsuccessful examples were projected on the screen. In the first two weeks, it was observed that the most common problems of the students were not starting the summary with an introductory sentence reflecting the topic and not providing integrity of meaning, including details and direct quotations. Information was given on these issues and the story of the previous week was worked on. The students were asked to look at their summaries with a critical eye and share the mistakes they found. Finally, they were asked to summarize the story called Portakal (Orange).

Week 4: Examples of successful, average, and unsuccessful summaries of the previous week were discussed. The evaluations made with the rubric were given to the students to see the strengths and weaknesses of their summaries. It was determined that the students could not show enough improvement in the criteria of ensuring the integrity of meaning, including the topic sentence in the introduction, using keywords, plot, and main idea. The narrative text structure, subject change determinants and the elements that make up the content scheme of the text were analyzed on the story of the previous week. In order to determine the keywords, it was explained that they should pay attention to the title of the text, the most frequently repeated words, the topic and main idea sentences, and the sentences expressing the changes in the protagonist's reactions, thus the changes of the main event. The keywords of the story titled "Portakal" were determined and how they could summarize the text with just keywords was illustrated. It was emphasized how using transition and connecting expressions when writing a summary ensures fluent expression. The students summarized the text called Kaşağı (Grooming Brush) within the framework of the information they learned.

Week 5: After examining the sample summaries of the previous week and distributing the rubrics to the students, studies were carried out on the subjects that the students could not improve. The problems seen in the previous week continued to be seen. The topics emphasized in the previous week were repeated in the story of Kaşağı. Students summarized the Son Kuşlar (Last Birds) story.

Week 6: Examination of the previous week's sample summaries and evaluations made with rubrics were distributed to the students. In the summaries of the previous week, problems were identified in terms of grammar, punctuation, spelling mistakes, integrity of meaning and consistent use of tense suffixes. Work was carried out on student summaries to correct errors on these issues. In addition, the number of students who failed in the criteria of introductory sentence, plot, details, keywords, and main idea increased compared to the previous week. In these subjects, analyses were made on the story of the Son Kuşlar (Last Birds). However, it was decided to complete the experimental process since the average score of 2 and above was seen in all criteria. The summary of the Kırmızı Pabuçlar (Red Shoes) was written as the final test.

Data Analysis

In order to determine the weekly development of summarization skills, frequency analysis was performed using the measures in the rubric. Since the summarization achievement scores were not normally distributed, the Wilcoxon Signed Ranks Test, one of the nonparametric tests, was used to determine whether there was a significant difference between the pre and post test data.

Reliability

The students' summaries collected as pretest and posttest were coded by two raters based on the criteria in the rubric. The agreement between the coding of the raters was analyzed by Cohen's Kappa Analysis. The kappa value is between -1 and +1. As the value approaches +1, the level of agreement between the raters increases and weakens as it approaches -1. Kappa value agreement scores are <.00 weak, .00-.20 insignificant, .21-.40 moderate, .41-.60 generally compatible, .61-.80 high and .81-1.00 very high (Landis & Koch, 1977). In this study, it was determined that the pretest scores were generally compatible with the 1st and 3rd criteria, highly compatible with the 2nd and 12th criteria and very highly compatible with the other criteria; the posttest scores were highly compatible with the 12th criterion and very highly compatible with all other criteria.

Research Results

Results Related to the Weekly Development of Students' Summarization Achievements

To explore the weekly development of students' summarization achievements descriptive analysis was conducted. The analysis results are seen in Table 3. and Table 4.

Table 3
Weekly Development of Summarization Achievement

		Form				Content						Style	
		1.Paper order	2.Paragraph number	3.Grammar, punctuation, spelling	4.Writing a new title	5.Content integrity	6.Introduction sentence	7.Plot	8.Details	9.Use of key words	10. Main idea	11.Use of time suffixes	12.Direct citation or imitation
Week 1	Inadequate	10	3	19	3	10	21	10	15	10	21	14	19
	Need to Improve	11	8	1	10	12	1	10	7	12	1	7	1
	Successful	1	11	2	9	0	0	2	0	0	0	1	2
Week 2	Inadequate	3	2	7	0	10	15	7	10	7	9	12	10
	Need to Improve	11	10	8	1	11	6	14	8	13	6	8	10
	Successful	8	10	7	21	1	1	1	4	2	7	2	2
Week 3	Inadequate	2	2	5	0	10	16	8	9	10	16	6	9
	Need to Improve	11	8	9	0	9	6	9	8	11	5	8	9
	Successful	9	12	8	22	3	0	5	5	1	1	8	4
Week 4	Inadequate	2	2	7	0	5	7	2	3	3	4	4	5
	Need to Improve	7	6	9	0	12	2	12	10	11	7	8	9
	Successful	13	14	6	22	5	13	8	9	8	11	10	8
Week 5	Inadequate	3	2	7	0	4	8	5	4	5	6	3	6
	Need to Improve	8	9	5	1	8	2	8	11	8	3	8	7
	Successful	11	11	10	21	10	12	9	7	9	13	11	9
Week6	Inadequate	2	0	3	0	3	2	2	3	4	2	3	5
	Need to Improve	5	1	7	0	5	2	5	6	5	1	4	5
	Successful	15	21	12	22	14	18	15	13	13	19	15	12

When the summaries of the 1st week are analyzed, the most successful criteria are the number of paragraphs ($f = 11$) and putting a new title ($f = 9$). There are no successful students in the criteria of integrity of meaning, introductory sentence, details, use of keywords and main idea. The number of successful students in the criteria of paper layout ($f = 1$), use of tense suffixes ($f = 1$), grammar, punctuation, spelling errors ($f = 2$), plot ($f = 2$) and direct quotation or imitation ($f = 2$) is quite limited.

It is seen that 21 students are successful in the criterion of putting a new title in the summaries written by the students in the second week and there are no summaries evaluated as inadequate in the related criterion. In the criterion of the main idea, in which there are no successful students in the first week, 7 students are successful. The number of summaries evaluated as inadequate in the introductory sentence ($f = 15$) and the use of tense suffixes ($f = 12$) is high. There is an improvement in all of the criteria compared to the first week, however, the number of successful students in the criteria of the integrity of meaning ($f = 1$), plot ($f = 1$), introductory sentence ($f = 1$), use of time affixes ($f = 2$), direct quotation or imitation ($f = 2$) is quite low.

In the summaries of the third week, it is seen that all of the students ($f = 22$) put a new title to their summaries. There is no successful student in the introductory sentence criterion. The number of successful students in the use of keywords ($f = 1$) and main idea ($f = 1$) criteria is quite low. While 1 student was successful in the main idea criterion in the third week, 11 students were successful in the fourth week.

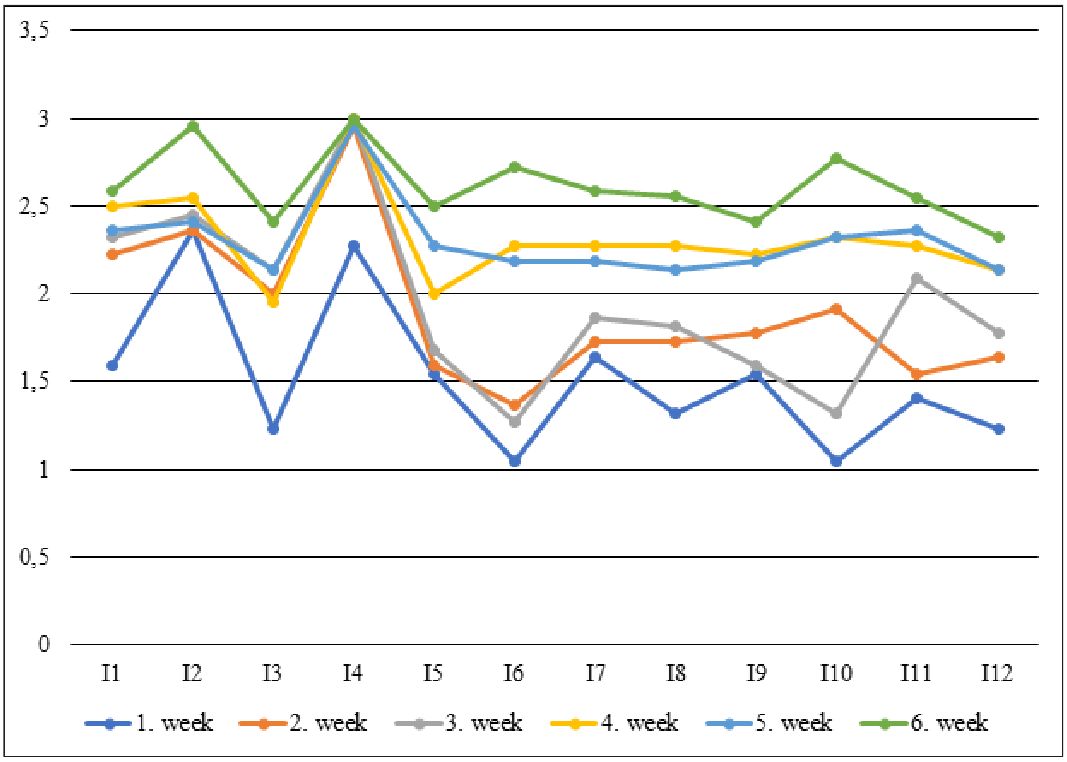
In the fourth week, the percentage of success (100 %) is repeated in the criterion of putting a new title. The lowest number of successful students is found in the criterion of integrity of meaning ($f = 5$). In all other criteria, the number of successful students is improved. In the introductory sentence criterion, where there were no successful students in the third week, there are 13 successful students in the fourth week. While one student was successful in the main idea criterion in the third week, this number is eleven in the fourth week.

In the fifth week summaries, the number of insufficient students in the criteria of introductory sentence ($f = 8$), plot ($f = 5$), details ($f = 4$), keywords ($f = 5$) and main idea ($f = 6$) increased compared to the previous week.

In the sixth week summaries, it is seen that the number of students who are successful in the criteria of putting a new title ($f = 22$), number of paragraphs ($f = 21$), main idea ($f = 19$) and introductory sentence ($f = 18$) is quite high. Although the level of success is at the top in all criteria as of the sixth week, there are students who are evaluated as inadequate in criteria other than the number of paragraphs and putting a new title. The criterion with the highest number of inadequate students ($f = 5$) is direct quotation or imitation.

The weekly course of summarization achievement determined according to the average scores obtained from the rubric in which text summaries were evaluated is given in Figure 1. The first 3 items of the rubric are about the format properties of the summary, items 4-10 are about the content and the last two items are about the style.

Figure 1
Weekly Development of Summarization Achievement



The results of the 6-week training period are shown in different colors. The dark blue line in Figure 1 represents the 1st week of the pretest scores and the green line represents the 6th week of the posttest scores. In the first week of the study, the scores obtained from summarization the text with an appropriate number of paragraphs ($\bar{X}$ = 2.36, *SD* = 0.73) and putting a new title to the summary text ($\bar{X}$ = 2.27, *SD* = 0.70) are above 2. The scores obtained from other criteria are below 2. In the 1st week, the lowest scores are obtained for starting the summary text with an introductory sentence that reflects the topic ($\bar{X}$ = 1.05 *SD* = 0.21) and ending the text with a sentence that gives the main idea ($\bar{X}$ = 1.05, *SD* = 0.21). In the second week, improvement is observed in all items. All format features of the abstract are above 2 points. Items 4-10 in the content features of the text and items 11 and 12 in the stylistic features continue to remain below 2 points. In the third week, the scores of the criteria related to form features continue to increase and are above 2 points. The score obtained from the criterion of putting a new title to the summary text ($\bar{X}$ = 3, *SD* = 0.00) is at the highest level. In the fourth week, the scores of all criteria except the criterion of compliance with grammar, spelling and punctuation rules ($\bar{X}$ = 1.95, *SD* = 0.79) are above 2. Although all of the scores are above 2 in the fifth week, it is noteworthy that there is a decrease in the criteria of paper layout (-0.14), number of paragraphs (-0.14), putting a new title (-0.05), introductory sentence (-0.0909), use of keywords (-0.05), plot (-0.09), and details (-0.14). In the 6th week, when the research was completed, and the post-test data were obtained, an increase was realized in all criteria.

The averages of the students' summarization achievement during the 6-week training period were examined and the data are presented in Table 4.

Table 4
Weekly Averages of Summarization Achievement

Week	*N*	$\bar{X}$	*SD*	Min.	Max.
1	22	1.52	.30	1.08	2.17
2	22	1.90	.42	1.25	2.83
3	22	1.94	.43	1.33	2.92
4	22	2.31	.50	1.17	3.00
5	22	2.30	.49	1.42	3.00
6	22	2.61	.40	1.33	3.00

As seen in Table 4, the lowest mean is at week 1 ($\bar{X}$ = 1.52, *SD* = 0.30) and the highest mean is at week 6 ($\bar{X}$ = 2.61, *SD* = 0.40). In weeks 1, 2 and 3, the mean of achievement is below 2. In weeks 4, 5 and 6, the achievement average is above 2. While the mean achievement of the summaries increases during the first 4 weeks, the mean achievement of the summaries in the 5th week ($\bar{X}$ = 2.30, *SD* = 0.49) decreases (-0.01) compared to the previous week ($\bar{X}$ = 2.31, *SD* = 0.50). When the averages of summarization achievements between weeks are examined, the highest increase (+0.38) is between the 1st and 2nd week.

Results Related to the Effect of Teaching Macrostructure and Superstructure on Summarization Narrative Texts Achievement

The Wilcoxon signed-rank test was conducted to explore the effect of teaching macrostructure and superstructure on summarization narrative texts achievement, and the results are presented in Table 5.

Table 5
Pretest-Posttest Difference in Summarization Achievement

Posttest - Pretest	*N*	Mean Rank	Sum of Ranks	*Z*	*p*
Negative Ranks	1	1.00	1.00	-3.97	.001
Positive Ranks	20	11.50	230.00		
No difference	1				

As seen in Table 5, in the post-test, one student's achievement is lower than in the pre-test, and one student's achievement is the same. In the post-test, 20 students increase their achievement. When the students' summarization achievement was compared between the posttest and pretest, it was determined that summarization achievement showed a significant difference in favor of the posttest (Z = -3.97, p<.01). According to this result, teaching macrostructure and superstructure is effective in summarization narrative texts achievement.

Discussion

In this research, it was explored how strategies based on determining the macrostructure and superstructure characteristics of the text affect the achievement of text summarization. As a result of the research conducted for 6 weeks in a single group pretest and posttest design, text summarization achievement showed significant differences in favor of the posttest.

It is noteworthy that in the first week of summarization achievement, there were no students who were successful in the criteria of semantic integrity, introductory sentence, details, use of keywords and main idea. Except for the criteria of adding a new title ($f = 9$) and number of paragraphs ($f = 11$), the number of successful students remained limited in other criteria. These results show that students' summarization skills were weak before the summarization strategies training. The reason for this may be that summarization skills are tried to be taught only through activities in course books. In the studies of Şengül (2005), Dilidüzgün (2013), Karadağ (2019), Özdemir and Eroğlu (2022), it was determined that the summarization activities in Turkish course books were insufficient for teaching summarization, indicating that there may be problems in developing summarization skills through activities.

According to the results obtained from the evaluation of summarization achievement, the highest increase in summarization scores (+0.3826) was between the 1st and 2nd weeks. This result is related to the second week of summarization teaching. However, the lowest increase in summarization achievement scores (+0.0417) occurred between the 2nd and 3rd weeks. This finding shows that the rate of development of summarization achievement does not follow a regular course and it is important to repeat the applications to reach the desired level of development.

The students who were evaluated as "successful" in summarization achievement, semantic integrity and use of tense suffixes increased every week. However, students who were evaluated as inadequate in the semantic integrity criterion remained stable in the first three weeks. Semantic integrity is a criterion based on the solid establishment of grammatical connections and the use of appropriate transition and connection expressions. Data from the first three weeks show that students had difficulty providing transition and connection points in their summary texts. In the study conducted by Deneme (2008) with secondary school students, it was determined that the students had problems in providing semantic integrity in their summaries.

It was determined that although the students' achievement in summarization in the six-week training period increased in the use of details and keywords, they could not reach the desired level. Problems with deleting details and using keywords show that students have difficulty distinguishing important information from unimportant information. In different summarization studies conducted with secondary school students, it was determined that there were problems in the strategies of deleting unnecessary information and separating important information from unimportant information (Aktaş & Bayram, 2017; Aydın, 2022; Bahap Kudret & Baydık, 2016; Çıkrıkçı, 2008; Erdem, 2012; Karatay & Okur, 2012; Özçakmak, 2015). Deletion is the most fundamental strategy in macrostructure construction rules (Brown & Day, 1983). The development of this strategy requires a long-term process.

In the results of the posttest of summarization achievement, it is seen that the least success was in the direct quotation and imitation criteria. In this criterion, 5 students were evaluated as inadequate, 5 students needed improvement and 12 students were evaluated as successful. The fact that students transfer information from the source text to their summary texts through direct quotation and imitation shows that they have problems in their ability to express it in their own words. In the study conducted by Çıkrıkçı (2008), it was determined that secondary school students frequently included direct quotations in their summary texts. Along with the direct quotation and imitation criteria, the criterion with the lowest number of successful students in the posttest was grammar, punctuation, and spelling errors. In the summaries examined, it was observed that students made especially the use of capital letters, letter errors and missing punctuation. The findings coincide with the findings of Süğümlü's (2020) study, which examined the application levels of secondary school students' spelling and punctuation rules. Grammar, spelling, and punctuation include the basic rules of Turkish. In order to eliminate the relevant deficiencies, students can internalize the relevant rules by using them throughout their lives.

When the weekly averages of summarization achievement were examined, a regular increase was observed in the first four weeks, while a decrease was observed in the fifth week averages. The text “Last Birds” was used in the fifth week summaries. The fact that the readability level of the text is medium difficulty may be the reason for the decrease in the average. Hellmann and Ehri (2020) determined in their study with fourth grade students that more successful summaries were obtained from easier texts. Also, this story, unlike others, is a situation story. Another reason for the decrease in averages may be that students are more accustomed to event stories. In the first three weeks of the research, the average summarization achievement scores were below 2. The average score remained below 2 in all 6 criteria in which the summary text was evaluated in terms of content. The content criteria of the summary are directly related to reading comprehension skills. It can be said that the average being below 2 in content criteria during a three-week period is an indication that students have problems in understanding and transferring what they read. In Özdemir's (2018) study, it was observed that the summarization achievement of Turkish teacher candidates reached an average of over 2 points in all criteria in the 3rd week. The secondary school students in this study increased over 2 points in all criteria in the 5th week. This result shows that the age factor is effective in the development of summarization achievement. As a matter of fact, in the study conducted by Brown et al., (1983) with student groups of different ages, it was determined that the age factor was effective in summarization achievement. The average, which rose above 2 by the fourth week, rose above 2.5 in the 6th week of the research. At the end of the sixth week, the highest average was recorded in all criteria. Considering the success averages obtained in the research and the results of other studies, it can be said that it is important to make planning in connection with the development characteristics of student groups when determining the duration of summarization strategies training.

Conclusions and Implications

In this study, the effect of summarization teaching based on determining the macrostructure and superstructure features of the text on the achievement of narrative text summarization was investigated. As a result of the research, a significant difference in summarization achievement was seen in the pre-test and post-test averages in favor of the post-test. An evaluation was made with 12 criteria regarding form, content, and style. Achievement has increased on all of these criteria. The least increase in criteria was seen in grammar, spelling, punctuation, and direct quotation and imitation criteria. The rate of successful students in these criteria was 54.5%. 59% of students were successful in details and keyword usage, and at least 68% were successful in other criteria. However, it was observed that students had difficulty when switching from an easy level to a medium difficulty level and from an event story to a situation story. These conclusions provide valuable implications for both educational practice and further research.

In order to improve students' summarization achievement, reading education should not be carried out only with questions about the meaning of the text. Teaching should be done on the elements that make up the macrostructure of the text and how these elements are arranged in the text according to their superstructure characteristics. The elements that make up the macrostructure of the text are the title, topic sentence, keywords, main and supporting ideas/events, content scheme, topic change markers and conclusion sentence. Depending on the superstructure of the text, these elements can be found in different parts of the text and different linguistic markers can be used. Analyzing the text in terms of these elements will contribute to the understanding of the text and is also important in determining which elements will be included in the summary. The research has shown that students need to study the texts repeatedly to determine the topic sentence, keywords, plot, and main idea and include them in the summary. It has been observed that these studies should continue for at least 4 weeks with 7th grade secondary school students.

Based on the research results, it is recommended that text structure criteria be included in the main language teaching program and repeated with different texts for a long time. Teachers should guide students in the summarization process and structure summarization education gradually. During the summarization process, they should clearly tell students what they need to do and be a model in showing them how to do it. Providing feedback in noticing the mistakes or truths made during the summarization process positively affects the students' achievement. Therefore, teacher and peer feedback should be offered.

This research is limited to narrative texts and secondary school students. There may be differences in determining summarization achievement depending on text types and the student's level. In further research, whether the achievement of summarization narrative and informative texts differs can be examined based on text structure teaching. Determining how long it takes for different age groups to develop narrative text summarization achievement is also one of the issues that need to be investigated.

The readability level of the texts and the organization of their content have an impact on the achievement of summarization. In summarization research, a transition should be made from easy texts to difficult texts. In the selected texts, the content should be presented in accordance with the genre characteristics.

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Declaration of Interest

The authors declare no competing interest.

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TEACHER EDUCATION STUDENTS' EXPERIENCES IN UNDERGRADUATE ONLINE MATHEMATICS COURSES

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Abstract

Having been shifted from traditional to online learning due to the community quarantine implementation, it is valuable to determine students' views about taking courses online. This research aimed to explore the teacher education mathematics major students' experiences with taking undergraduate mathematics courses online, precisely the benefits and challenges they encountered, and in what way they dealt with these challenges. The design used in this study is qualitative exploratory research by distributing open-ended questions to selected Bachelor of Secondary Education in mathematics students (N = 76) from a state university in the province of Bulacan, Philippines. Data were explored through thematic coding. The results indicated that among the gains of taking mathematics courses online, the students mostly gained from a convenient study time to access applicable web-based references and resources. In spite of unpredictable internet networks, limited teacher and peer interaction, vague learning content and discussions, some distractions, and a lack of satisfactory learning resources, independent and self-paced study paired and fired with enough self-motivation are suggested.

Keywords*: mathematics courses, online learning, online mathematics, teacher education, thematic coding*

Introduction

In mathematics, educators have long identified the advantage of active student participation in supporting deep learning of key mathematical ideas and procedures. This mainly positions students in beneficial situations to acquire relevant experiences. Accordingly, the concept of educative experience has been critical in conceptualizing how students come to join and focus on an activity. Experiences are educational when they encourage students to boost their vigor and complement their improvement (Christodoulou, 2009). In this twenty-first century era, information and communication technology (ICT) has been influential in education to support learning and flexibility and efficiency of curriculum delivery (Bhattarai, 2019). ICT offers excellent possibilities for education, especially in the way in which students can access and interact with information. Using this has turned into a way of life, with the convenience of a decent internet signal reachable to anybody with a digital device. As a result, online learning has become prevalent as a substitute for usual face-to-face classes (Fung et al., 2014).

The onset of the COVID-19 pandemic has forced a significant number of teachers and school institutions to operate with online education technologies. However, even before the pandemic hit the entire globe, mixed views of the benefits of online learning were observed. According to Sutherland (2008), "When faced with a new technology, we make sense of this in terms of our experience with older technologies" (p. 4). Some students perceived that online learning did not offer a true reflection of their effort (Brown & Lally, 2018). Others perceived OL to establish "... its effectiveness throughout the years, mainly because of its flexibility

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exhibited at different levels: pedagogical design, learning scenario, learning content, online tutoring" (Stoytcheva, 2018, p. 1).

A Need for Online Learning (OL)

The United Nations (UN) last 2015 set off a worldwide agenda for sustainable development by 2030. At its essence are the seventeen Sustainable Development Goals (SDGs), with goal 4, which aim to safeguard equitable and inclusive quality education and provide lifelong learning opportunities for all (Annan-Diab & Molinari, 2017; Owens, 2017). Unfortunately, as the COVID-19 pandemic spread, most countries declared the temporary closure of schools, impacting a higher fraction of students worldwide. As for the UN (2021), school closures affected by the pandemic produced damaging costs for students' learning. And so, special efforts are looked for to recover learning losses. To lessen these apparent losses that may accrue in education, many schools offer distance learning to their students. However, this alternative is only accessible to some (United Nations, 2020). The Commission on Higher Education (CHED), through CHED Chairman De Vera (2020), released Memorandum Order No. 4 series of 2020 for the implementation of flexible teaching and learning in higher education: "It has become an urgent need to explore other innovative modalities that will facilitate migration from traditional to flexible teaching and learning options" (p. 1). FL is established to the students' needs, permitting flexibility of time, access, schedules, and innovative assessments (Cassidy et al., 2016; De Vera, 2020).

As a response, Bulacan State University (BulSU) (2020; 2017a; 2017b), the largest state university in the Central Luzon region and one in the Philippines with over a thousand faculty members and thousands of students across five campuses, proposed three possibilities for FL modalities to its community: Synchronous Online Learning (SL), Asynchronous Online Learning (AOL), and Remote Print Learning (RPL). SL is a kind of learning that happens in real-time; AOL occurs at their own pace, and RPL is for those who prefer printed learning materials. Most of the students in the BulSU community favored SL and AOL. As a rule, SL students are required to regularly meet their teachers online and be involved in any of the online-related activities posted [initially] through the GSuite applications, particularly Google Classroom and Meet [which then migrated to MS 365 applications, mainly MS Teams]. Teachers have to send carefully planned pre-recorded activities. AOL students, on the other hand, meet their teachers at least twice a month, and synchronous meeting schedules vary on the majority's online availability. The teachers have to set up e-modules, video lessons, and innovative assessment tasks to assist students. OL has primarily been the mode of instruction delivery for a number of years in the university. For this reason, the present researcher, a faculty member from the College of Education at BulSU, as led by SDG4, desires to explore and record students' insights and experiences in OL as most school institutions are being stirred to practice and move toward more online and/or, at least, blended courses to meet student needs and safeguard equitable and inclusive quality education. BulSU Educators faced a sudden shift to digitalization.

Some Reported Challenges in OL

Positive implementation of teaching and learning in OL settings in higher education entails overwhelming challenges (Moore & Fisher, 2017). In the study by Kim, Liu, and Bonk (2005), the majority of Master of Business Administration (MBA) students affirmed that OL is more complex than learning in classroom-based classes. The delayed teacher feedback due to the absence of real-time interaction with the teacher was challenging to their OL. A study further reveals that teachers' lack of feedback is a considerable barrier to effective online collaboration in higher learning institutions (Muuro et al., 2014). In a medical education setting, students expressed a need for more instant, direct, and real-time teacher feedback to confirm that their understanding and energies were on the correct route. The typical challenge was the asynchronous communication setting and lack of face-to-face communication with peers, which resulted in problems with establishing collegial interactions and tracking progress (Dyrbye et al., 2009). In a study by Meyers and Bagnall (2016) with ten undergraduate learners of at least forty-five years of age, the OL challenges fell into three different but interconnected factors: technology use, hypermedia use, and independent learning. Concerns about technology use occurred remarkably from the lack of familiarity with the technology and its complexity. Problems with hypermedia use occurred from locating appropriate hypermedia-based resources from various web resources. The most noticeable issues about independent learning were their knowledge deficits and the related preferences for cognitive reinforcement: individual tutoring, group-based, and work-based collaborative learning. As a consequence, in both synchronous and asynchronous online instructions, although considered to be profoundly innovative pedagogical modalities, a teacher needs to develop novel competencies, particularly regarding technology use and the capability to inspire e-students (Leo et al., 2009).

Some Reported Advantages of OL

The advantageous feature for them is that the format offered them learning flexibility and opportunities for more interaction with teachers outside of real-time online meetings. That is to say, the OL provides students and teachers with a stage for shared discussion outside the classroom, permitting them to organize their thinking by viewing recorded instructional videos (Kim et al., 2005; So, 2012). The online role of the faculty is redefined as a facilitator who makes a space for learners to be involved (Bishop et al., 2018). The synchronous online meeting where undergraduates can see their learning is urged. Student enjoyment supports becoming a determined online learner (Tempelaar et al., 2012), promoting elaboration and metacognition (Artino & Jones, 2012). In the study of Zembylas, Theodorou, and Pavlakis (2008), for several students, the anxiety level related to OL was high at the start of the course, but then it slowly reduced, specifically when the students became more acquainted with online communication and started to develop a more solid sense of emotional connection among themselves via numerous communication measures, e.g., asynchronous discussions, phone calls, and emails. For successful online communication, it is vital to keep channels for both synchronous and asynchronous interactions (Cividino, 2009).

In line with the experience-based and literature-based review, it can be articulated that there are some advantages and challenges in the implementation of OL. This situation may also be the case in the BulSU community. With this in mind, as a faculty from BulSU College of Education, I realized the value of exploring OL experiences of teacher-education students, in particular, for mathematics majors, as it can explain the educative experiences of students. As a response, this study aimed to explore the experiences of teacher-education mathematics major students taking mathematics courses online. In particular, it sought to address the following : (1) the advantages the teacher-education mathematics major students see in taking their undergraduate mathematics courses online; (2) the difficulties the teacher-education mathematics major students have met in taking their mathematics courses online; and (3) the manner in which the teacher-education mathematics major students address their difficulties in understanding mathematics lessons when delivered online. This paper contributes to the body of knowledge of what really takes place during the OL setup in a Philippine setting.

Research Methodology

General Background

The researcher viewed himself with a social constructivist worldview with a critical realism research philosophy. As per Creswell (2009), social constructivists seek insights into the realm where they work and live, dependent on the participants' opinions of the situation being explored, to make a sound judgment of the meaning others say about the world. A critical realist argues that, as researchers, what occurs in the social sphere can be known if they know the social forms that offer growth to the experiences they seek to comprehend (Saunders, 2019). With this in mind, this study used qualitative-exploratory research (Stebbins, 2008, p. 327). Researchers explore when they hold little or no scientific understanding about what they desire to study but still have reason to think it includes elements worth discovering. The researcher first defined the objectives. Next, the researcher identified the target population. The researcher selected the teacher-education mathematics major students in the College of Education, Bulacan State University, enrolled in the 2021–2022 school year. Then, the researcher chose the mode of data collection. The researcher strategically collected the data through open-ended questionnaires. Afterward, the data was explored and analyzed via the transcripts. In the sorting process, the researcher shaped descriptive concepts and abstractions, connecting each transcript to see common properties, and melding them into concepts and generalizations.

Participant

The target population for this study was the teacher education students enrolled in the Bachelor of Secondary Education (BSEd) mathematics program of Bulacan State University College of Education, Philippines, who had taken online undergraduate mathematics courses for at least one semester. The total target population is 189. This study was conducted during the second semester of the school year 2021–2022. Stratified sampling was used to determine the samples. A stratified sample is gained by dividing the population into subgroups and randomly selecting representatives from each subgroup (Fraenkel & Wallen, 2009). The preservice mathematics teachers were divided into sections. The researcher produced five subgroups—one section each from the first year to the third year and two sections from the fourth year, for a total of 100. An education expert at the Far Eastern University Institute of Education carefully chose the number of samples as enough to be the basis of all qualitative data. The researcher then selected twenty from each section by means of a randomizer app. These 100 individuals were invited to join in the study. Of the 100 likely participants, only seventy-six (*N* = 76) responded voluntarily. During this second semester, the fourth-year participants had already taken eight (8) mathematics courses online, the third year with eleven (11), the second year with seven (7), and the first year with three (3) mathematics courses online (see Table 1).

Table 1
Mathematics Courses Already Taken by the Participants

Year Level	Mathematics Courses Already Taken	
	via Face-to-Face	via Online
First Year	0	3
Second Year	0	7
Third Year	4	11
Fourth Year	11	8

Note: There are 20 mathematics courses in the BSED Mathematics curriculum

Data Collection

To collect the data for the study, the researcher used an unstructured survey questionnaire. The items are open-ended, requiring the respondents to write information, comments, and feedback freely (Efron & Ravid, 2013) on the perceived benefits of studying undergraduate mathematics courses online, the accompanying difficulties, and how they deal with them.

The instrument was validated by a research expert from the Far Eastern University Institute of Education. The validation process progressed through a series of email exchanges and consultation meetings. It was advised to utilize unstructured responses in answering the research questions. After some alterations, the researcher was able to finalize the set of open-ended questions to be included in the instrument. The Google Forms version of the instrument has also been noted and approved. The instrument was administered to the respondents via Google Forms since this is in the pandemic days when the movement of people is strictly monitored. The Google Forms has two (2) major sections: Section 1, the Informed Consent section, and Section 2, the actual open-ended questions. Section 2 has two (2) parts: Part 1, the profile of the respondents, and Part 2, the key questions. Only data from target participants who had confirmed voluntary involvement and replied within a week after administration were compiled and stored in a spreadsheet.

Data Gathering

The researcher asked for approval from the college dean to conduct the study and, after getting permission, moved to the actual survey. The questionnaires were distributed via Google Forms. As for the ethical considerations, informed consent, respect for confidentiality and anonymity, and voluntary participation were strictly observed. The researcher clarified all vital matters about the study in the first section of the Google Forms survey and asked to confirm voluntary involvement. The students were given ample time to reply. The data were transferred in a spreadsheet afterward for further analysis.

Data Analysis

To analyze the responses, thematic coding analysis was used. "Coding is a way of indexing or categorizing the text to establish a framework of thematic ideas" (Gibbs, 2007, p. 38). Due to the nature of the qualitative data gathered, the researcher used line-by-line coding. In line-by-line coding, the researcher pays close attention to what the respondent is saying and creates codes that reflect respondents' experiences and perceptions (Gibbs, 2007, p. 52). Thus, it should remain grounded in the data. After transferring the data to a spreadsheet, each student was assigned a unique ID number. The data were transformed into readable text via the MS Word application. The researcher immersed himself in the data and identified set categories, looking for themes within each category. Finally, the researcher read the data slowly and carefully and divided them into subthemes (Efron & Ravid, 2013).

Research Results

Advantages of Taking Mathematics Courses Online

The first research question was to find out what advantages students see in taking mathematics courses online. To answer this research question, the respondents were asked what benefits they gained from taking online mathematics courses based on their experiences during the past months. They were surveyed to list up to three distinct benefits. The responses were analyzed via thematic coding analysis. Based on the results of the thematic coding, students' perceptions of the benefits of taking mathematics courses online are categorized under four (4) main themes from seventy-six (76) respondents.

Table 2
Main Themes Distribution of Students' Perceptions of the Benefits of Taking Mathematics Courses Online

Main Themes	*f*	%
Accessibility of time	42	55.26
Accessibility of resources	37	48.68
Opportunities for better critical thinking	38	50.00
Demonstrated self-motivation	21	27.63

Table 2 shows the main themes distribution of the students' perceptions of the benefits of taking mathematics courses online. It can be seen that 42 (55.26%) of the total respondents are categorized under the main theme of *accessibility of time*, 37 (48.68%) are categorized under *accessibility of resources*, 38 (50.00%) are categorized under *opportunities for better critical thinking*, and 21 (27.63%) are categorized under *demonstrated self-motivation*.

It can be noticed that the three (3) topmost main themes in the distribution in Table 2 were *accessibility of time*, *opportunities for better critical thinking*, and *accessibility of resources*. This suggests that the respondents were able to see the benefits of the accessibility or availability of time, resources, and opportunities for better critical thinking from taking mathematics courses online. On the other hand, the main theme in the distribution with the lowest frequency was the *demonstrated self-motivation*.

Table 3
Subthemes Distribution of Students' Perceptions of the Benefits of Taking Mathematics Courses Online

Main Themes	Subthemes	*f*	%
Accessibility of time	More time for posted activities	8	19.05
	More time for studying specific topics	9	21.43
	More time for practice	4	9.52
	Flexible and convenient study time	19	45.24
	Managing time more efficiently	10	23.81
Accessibility of resources	Access to web resources	28	75.68
	Access to recorded discussions	9	24.32
	Access to devices and applications	8	21.62
Opportunities for better critical thinking	Foundation skills	17	44.74
	Analytical skills	14	36.84
	Problem-solving skills	14	36.84
	Metacognitive skills	9	23.68
Demonstrated self-motivation	Pleasure	13	61.90
	Utility	9	42.86

Table 3 shows the subthemes distribution of the students' perceptions of the benefits of taking mathematics courses online. Under the main theme, accessibility of time, there are five subthemes: *more time for posted activities* (19.05%), *more time for studying specific topics* (21.43%), *more time for practice* (9.52%), *flexible and convenient study time* (45.24%), and *managing time more efficiently* (23.81%). Under the main theme, accessibility of resources, there are three subthemes: *access to web resources* (75.68%), *access to recorded discussions* (24.32%), and *access to devices and applications* (21.62%). Under the main theme, opportunities for better critical thinking, there are four subthemes: *foundation skills* (44.74%), *analytical skills* (36.84%), *problem-solving skills* (36.84%), and *metacognitive skills* (23.68%). And under the main theme, demonstrated self-motivation, there are two subthemes: *pleasure* (61.90%) and *utility* (42.86%).

For the main theme, accessibility of time, the subtheme with the top frequency is *flexible and convenient study time*. For the main theme, accessibility of resources, the subtheme with the top frequency is *access to web resources*. For the main theme, opportunities for better critical thinking, the subtheme with the highest frequency is *foundation skills*. This indicates that students primarily see the benefits of having flexible and convenient study time, as well as the availability of web resources while taking mathematics courses online and being able to acquire the foundation skills. Having a flexible and convenient study time, combined with the ease of use of web resources, provides students with a better chance of adequately absorbing and retaining the information, at least for foundation skills. Although the foundation skills may not be sufficient to progress to higher levels of thinking, these skills are still necessary, like any other mathematics skill. This gives the impression that they essentially adopt self-paced learning.

> Aside from what the instructor gave us, we can search for more information and examples, which can help us to better understand the lesson. – R47
> I can study and learn mathematics whenever it is convenient for me. – R74
> I gained more knowledge even though it's online. – R48
> I became familiar with the formulas. – R4

In contrast, for the main theme, demonstrated self-motivation, *utility* is the subtheme with the smaller frequency. This suggests that, given the accessibility of time and resources, only a few students see the usefulness of taking mathematics courses online and are self-motivated by it.

> I have gained personal people I can rely on and ask because
> I can express myself online. – R13

Difficulties in Taking Mathematics Courses Online

The second research question was to determine what difficulties the students met in taking mathematics courses online. To answer this research question, the respondents were asked what difficulties they encountered when they attended online mathematics courses. They were surveyed to list up to three distinct difficulties. The responses were analyzed via thematic coding analysis. Based on the results of the thematic coding, the difficulties of taking mathematics courses online are categorized under five (5) main themes from seventy-six (76) respondents.

Table 4

Main Themes Distribution of Student Difficulties in Taking Mathematics Courses Online

Main Themes	*f*	%
Technical Issues	56	73.68
Communication Issues	30	39.47
Learning Environment Issues	30	39.47
Subject Matter Issues	37	48.68
Motivation Issues	14	18.42

Table 4 shows the main themes distribution of the student difficulties in taking mathematics courses online. It can be seen that 56 (73.68%) of the total respondents are categorized under the theme of *technical issues*, 30 (39.47%) are categorized under *communication issues*, 30 (39.47%) are categorized under *learning environment issues*, 37 (48.68%) are categorized under *subject matter issues*, and 14 (18.42%) are categorized under *motivation issues*.

It can be noticed that the four (4) topmost main themes in the distribution in Table 4 were *technical issues*, *subject matter issues*, *communication issues*, and *learning environment issues*. This indicates that the respondents mainly encountered various technical, subject matter, communication, and learning environment issues in taking mathematics courses online. On the other hand, the main theme in the distribution with the lowest frequency was *motivation issues*.

Table 5

Subthemes Distribution of Student Difficulties in Taking Mathematics Courses Online

Main Themes (Issues)	Subthemes	*f*	%
Technical	Unstable internet connection	53	94.64
	Lacking adequate learning resources	14	25.00
	Electric power interruption	3	5.36
Communication	Limited teacher support	18	60.00
	Difficulty in conveying solutions	13	43.33
	Poor peer interaction	3	10.00
Learning Environment	Some distractions	21	70.00
	Difficulty focusing on lessons	12	40.00
Subject Matter	Vague learning content	26	70.27
	Vague lecture discussion	13	35.14
Motivation	Poor time management	7	50.00
	Lack of stimulating tasks	3	21.43
	Feelings of overwhelm	7	50.00

Table 5 shows the subthemes distribution of the student difficulties in taking mathematics courses online. Under the main theme, technical issues, there are three subthemes: *unstable internet connection* (94.64%), *lack of adequate learning resources* (25.00%), and *electric power interruption* (5.36%). Under the main theme, communication issues, there are three subthemes: *limited teacher support* (60.00%), *difficulty in conveying solutions* (43.33%), and *poor peer interaction* (10.00%). Under the main theme, learning environment issues, there are two subthemes: *some distractions* (70.00%) and *difficulty focusing on lessons* (40.00%). There are two subthemes under the main theme, subject matter issues: *vague learning content* (70.27%) and *vague lecture discussion* (35.14%). Under the main theme, motivation issues, there are three subthemes: *poor time management* (50.00%), *lack of stimulating tasks* (21.43%), and *feelings of being overwhelmed* (50.00%).

For the main theme, technical issues, the subtheme with the highest frequency is an *unstable internet connection*. The subtheme with the higher frequency is *vague learning content* for the main theme, subject matter issues. The subtheme with the highest frequency is *limited teacher support* for the main theme, communication issues. For the main theme, learning environment issues, the subtheme with the higher frequency is *some distractions*.

Unstable internet connection was the most prevalent among all subthemes relating to technical issues. This caused the students to miss some parts of the discussion, such as the solving part, making them confused about a topic or giving them a hard time understanding the whole lesson, requiring them to rewatch the recording if it is available. While vague learning content appeared to stem not from the delivery mode but from the content itself, students revealed that a struggle they faced was the vagueness and difficulty of understanding the learning content, especially when they could not absorb the lessons discussed on a specific period.

> Other technicalities, such as a poor internet connection, prevent me from getting what the teacher discussed, especially when the audio becomes choppy. – R66
> I can't concentrate sometimes, especially when my internet connection is unstable. I need to rewatch the recording. Unlucky for me, [if it] wasn't recorded. – R42
> Sometimes, I feel left behind, as if all of my classmates already agreed that
> they understood the topic, while I'm still puzzled about where those things came from. – R66

With limited teacher support, students had difficulties asking relevant questions such as feedback or whenever they met difficulties in the lessons or topics they could not grasp. Some of them were shy to ask questions as they might distract the flow of the discussion online. For some respondents, it was draining to know that whenever they could not understand lessons, they could not inquire about anyone when studying. Similarly, due to distractions in the learning environment, the respondents argued that their surroundings were not suited for mathematics learning and not as conducive as the school environment due to the noise and other distractions their environment at home brought.

> If I have questions or concerns, I can't have my answer right away. – R73
> Some parts are not clear to me, which I do not ask the teacher anymore because I am shy. – R57
> The environment I have at home is not totally suited for mathematics learning. – R18
> The background noise around is very loud, so I can't focus most of the time
> while listening to difficult topics. – R64

In contrast, the subtheme with the smallest frequency is the *lack of stimulating tasks* for the main theme, motivation issues. To a few, online learning was not engaging as they felt sleepy and unmotivated to attend the class, for they were used to the face-to-face modality.

> I sometimes have no motivation to attend the class because
> I am used to the face-to-face modality. – R42

Addressing the Difficulties Encountered in Taking Mathematics Courses Online

The third research question was to determine how the students addressed the difficulties in understanding mathematics lessons when delivered online. To answer this research question, the respondents were asked how they dealt with the difficulties they faced in taking Mathematics classes online. They were surveyed to list at least one for each difficulty they listed in survey question 2. The responses were analyzed via thematic coding analysis. Based on the results of the thematic coding, students dealt with the difficulties they encountered in taking mathematics courses online in various ways and were categorized under five (5) main themes from seventy-six (76) respondents.

Table 6
Main Themes Distribution of How Students Address Difficulties Encountered in Taking Mathematics Courses Online

Main Themes	*f*	%
Addressing Technical Issues	36	47.37
Addressing Communication Issues	25	32.89
Addressing Learning Environment Issues	23	30.26
Addressing Subject Matter Issues	42	55.26
Addressing Motivation Issues	15	19.74

Table 6 shows the main theme distribution of how students address difficulties in taking mathematics courses online. It can be seen that 36 (47.37%) of the total respondents are categorized under the theme of *addressing technical issues*, 25 (32.89%) are categorized under *addressing communication issues*, 23 (30.26%) are categorized under *addressing learning environment issues*, 42 (55.26%) are categorized under *addressing subject matter issues*, and 15 (19.74%) are categorized under *addressing motivation issues*.

On Technical Issues

Checking the devices and the internet connection before the online mathematics class was a preemptive step for students. To avoid the devices running slow, links to the applications were used, and not installing the actual apps. Deleting unnecessary files to free space to lessen the lag or delay was performed. For respondents who lack adequate resources, they use the phones of their siblings, relatives, or even neighbors when possible.

In the absence of a Wi-Fi connection, the respondents generally pay for loads to have mobile internet data that they can use to surf the web, mainly to attend mathematics classes online. They attempt to connect to the online mathematics class via the data connection in the occurrence of an unstable internet connection, or at least as a backup plan. When necessary, they try to connect with others' data connections through mobile hotspots, either to house members or neighbors; or find a location or avail phone sim card with a better internet signal. For some, mobile internet data was used exclusively for online mathematics classes to save or not consume too much data. When the internet connection gets lost during online mathematics class, they try to connect as much as possible. They try to refresh the internet, and hence having long patience is of the essence. And if they cannot make it or handle the issue, they notify the teacher that they were unable to connect. When the internet connection becomes stable, they rewatch the recorded discussion if available. They also ask their peers about the lesson when necessary.

> I make sure to have backup data whenever the internet connection collapses.
> I also notify my instructor of the situation and rewatch the recorded video of the discussion once the internet connection stabilizes. – R40
> I just take advantage of my long patience when I have poor connections. Sometimes, my siblings let me connect to their phones' hotspots. – R54
> For technical issues, I always check my gadgets before an online class starts. – R12

On Communication Issues

The respondents try to start interacting with their teachers by cautiously communicating sensible information by virtually raising their hands to get their attention. This is to ask them for more illustrations, demonstrations, or simulations when needed or to respond to their queries. The respondents answered their teacher's queries by sending their solutions via the chatbox. If this is not practicable, they took screenshots of their solutions, copied and pasted them into the MS Word application, and then sent them to the online platform to show their answers decently. Due to the scarcity of mathematical characters on the keypad and when the mathematics teachers call for an immediate response, the respondents simply type in the mathematical symbols in words and explain them in the chatbox. When the respondents could not immediately interrupt or ask the mathematics teachers while in the online class, they asked their classmates who knew the lesson to explain things they could not grasp or understand to ask for help when they had questions. They send their queries to their classmates via private messages to get precise information and not to distract their teacher's flow of discussion. For some shy type students, they ask their classmates to ask their questions to teachers on their behalf. For respondents who could not finish online classes for valid reasons, they responsibly asked their classmates about what they had missed. Generally, they asked their classmates or teachers privately.

In some cases, respondents wait for the discussion to end before asking their teachers about their concerns. Some of them wait for their teachers to provide a presentation copy and/or return their activity outputs. On the incidence of limited interaction with teachers or peers, the respondents, more often than not, supplement it by reading relevant web resources and watching videos pertinent to the topic in mathematics.

> I screenshot it or copy and paste it into MS Word whenever I want to show my answer in a good way. Sometimes, I type the symbol (in words) and explain it in the chat section. – R33
> Because I cannot ask my professors immediately while we are in the class, sometimes I send them a private message for my queries, and gratefully, they respond to my questions. – R30
> I do research and consult with my other classmates. – R57

On Learning Environment Issues

The respondents usually find a quiet place, try to calm down, and practice concentration to be less distracted. They do this by closing the doors and windows of their room or moving from one room until they find the best place for online study. Some of them wait until everybody sleeps before watching the recorded video lessons. They usually clean their surroundings when reviewing mathematics lessons to be less distracted. They politely ask their family members to keep quiet and reduce noise, or in some cases, they go to neighbors' houses with peaceful environments.

To focus more, the respondents avoid opening social media accounts, hold a pen and paper, write important notes during online discussions, and, if possible, participate in the discussions to understand the lesson more.

> I sometimes went to my auntie's house because there were minimal interruptions to study. – R20
> I talk to the people who are making noises since we don't have a silent area to study. I log out of my Facebook account, or I turn on the 'do not disturb' mode on my phone so that I will not get any notification. – R56
> I keep myself focused by getting a pen and paper and writing the important notes my professor is saying. – R24

On Subject Matter Issues

During online mathematics classes, they try to solve and answer the problems provided by their teachers on their own. At the rate of vague content and discussions, the respondents mostly conduct extensive research, browse for more information, and review almost all night. To wipe out vagueness, they watch relevant video lessons and tutorials, e.g., YouTube or Google, or find other sources on the web, especially when they feel the class lessons were so hard and could not be learned quickly through the online discussion. They read related materials and solve similar exercises found on the web for better insight. They keep on reading, again and again, mathematics problems until they understand the idea. They also search for problems that were not heavily discussed. This serves as their reviewer. They study the lesson until they get how it is done.

After the online mathematics class, they typically search for other references to supplement the discussion, from the easy ones to the most difficult ones. They do this to clarify confusing parts of the discussion or things they come across after the online class which cannot be answered right away by the teacher. Although they undoubtedly watch and rewatch the teachers' recorded discussions, they do not basically rely on them. They try different approaches to learning things and mix them with an amount of practice. Likewise, they jot down notes while attending the class discussion and even after it via the recording, as if they were in a face-to-face classroom. In some cases, they ask their classmates or hire a tutor to guide them at home.

> I play the recording of our class which serves as my reviewer, especially If I can't follow the steps being discussed. I researched and watched more related discussions on YouTube and read some articles on Google. – R30
> After class, I always review some information that is hard to understand in one time reading. I searched on YouTube to add references. I focus first on easy things and then proceed to difficult ones. – R11

On Motivation Issues

The respondents try to manage their time efficiently by taking notes on what they should be doing in the day and what they have to accomplish to keep themselves motivated. To overcome procrastination, some enter the online meeting as early as ten minutes before the actual schedule to discipline themselves. They try to prioritize and focus on school by always seeing that no tasks are left unanswered. Even if, at some point, they struggle in adapting to new situations, they basically get over it through time by adjusting themselves and trying to cope no matter how difficult it is for them. Some of them go back to the sample problem and solve it independently. They try to build more confidence. They inject into their hearts and minds why they have to pursue this journey and continue with the mathematics course online, the people behind their goals–their family.

> I am trying to remember why I am continuing this journey, the people behind my goals, and my goals. With that, I am able to regain my motivation and continue the course. – R42
> I keep myself motivated despite learning online. – R62

Discussion

The study showed that among the benefits of taking mathematics courses online, convenient and flexible study time to access relevant web resources to provide themselves with at least foundation skills opportunities mainly were coded (Kim et al., 2005; So, 2012). This assumed an advancement in students' potential to perform independent learning. Similarly, although taking mathematics courses online is reported as beneficial in providing opportunities for better critical thinking, the respondents do not primarily engage in metacognitive processes but gain more from the benefits of the convenience of time and web resources. In line with Yang and Chou (2008), in this era of internet and information, where there is much untrustworthy and incomplete information waiting to be processed, educators should [have started to] think about how to nurture students' critical thinking disposition. Results also showed that among the difficulties met by the students in attending mathematics courses online, unstable internet connection, vague learning content, distractions, and limited teacher support were the most frequent ones (Leo et al., 2009; Meyers & Bagnall, 2016).

Results further showed that to be able for them to deal with technical issues on the internet and other learning resources, they typically check their devices and internet connection before the online class, set up a backup plan to pay for loads to acquire mobile internet data, and free enough space for their devices so as not to lag or slow down, respectively. To deal with the communication issues, they either communicate with their teachers or peers after class or interact with them privately (Cividino, 2009; Zembylas et al., 2008). Due to the lack of mathematical characters on the keypad, they simply type in the mathematical symbols in words and explain them in the chatbox when asked to respond to the teacher's call. To address the learning environment issues, they usually find a quiet place, try to calm down, and practice concentration to be less distracted. To wipe out vagueness in both learning content and discussions, they watch relevant video lessons and tutorials or find other sources on the web, especially when they feel the lessons were so hard and could not be learned quickly through the online discussion. From the results, accessing relevant web-based resources took place as their means of coping with the learning deficits caused by the difficulties they had met (Cividino, 2009; Kim et al., 2005; So, 2012; Zembylas et al., 2008). And to motivate themselves, they try to manage their time efficiently and inject into themselves why they have to pursue and continue all these mathematics courses online.

For the study limitations, this research was a small-scale qualitative-exploratory research and considered only a small number of participants from a state university in Bulacan, Philippines, from the Central Luzon region. At the same time, data transcripts were collected online.

Conclusion and Implications

It has been determined that the prevalent advantages of taking mathematics courses online are the accessibility of web resources and the convenience of time. Although there are various difficulties that the students have met, the above benefits may resolve and act as a remedy to settle these challenges. Knowing that there was this availability of time and web resources, the students were able to cope with this situation. There is still hope for this transitory situation through independent, self-paced study, particularly when paired with enough motivation. Consequently, it highlights the need to strengthen the students' self-motivation. Even though it was found that students perceive the benefits of online learning as providing a venue to demonstrate self-motivation, it still needs to be strengthened as it is way too far from the other perceived benefits. Similarly, teachers should provide or introduce a broad set of relevant web-based references and resources that students can explore with ease of time to help them operate independently in the self-paced study. Lastly, it is proposed that teachers provide space for students to aid them in strengthening the perceived pleasure and utility of online learning, enhancing student's self-motivation and so for students to be involved.

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EXAMINATION OF THE REASONS THAT LEAD TEACHERS TO ABANDON THE CURRICULUM

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Abstract

Educators may occasionally neglect certain parts of the curriculum that they consider relatively unimportant. There are instances when inadequate time and pupils' readiness for central examinations are cited as justifications for these occurrences. The aim of this research was to examine the reasons that lead teachers who teach courses that are tested on the Upper- Secondary School Entrance Exam, which is the central exam for 8th *graders, to ignore the curriculum according to the opinions of the teachers. The research was designed according to the case study, a type of qualitative research. The study group of the research consists of a total of 15 teachers, 6 of whom work in private schools and 9 of whom work in public schools, in the province of Hatay in the 2021-2022 academic year. A purposive criterion sampling method was used to select the teachers. Research data were collected through a semi-structured interview form and analyzed by content analysis method. It was found that most of the teachers interviewed ignored or abandoned the curriculum because of central exams or external pressures. It was stated that some reasons related to school administrators, parents and students forced teachers to make changes in course teaching methods and processes or forced them to abandon the curriculum.*

Keywords: *Educational curriculum, commitment to the curriculum, curriculum abandonment, central exams, teacher examinations*

Introduction

The curriculum is defined by some authors as a formal course of study with a content-focused emphasis, while others place more emphasis on the learning process or the teaching approach when they define the curriculum as the culmination of each learner's experiences along with the significance of statements of anticipated learning outcomes or behavioral targets (Lunenburg, 2011). Those outcomes and targets of learners need to be checked and evaluated during the educational process through exams, central exams, or alternative measurement tools within the scope of measurement and evaluation, which is one of the four basic components of the curriculum.

However, up to school age even from the moment of their birth, humans wonder, research, discover, learn, and develop knowledge from all their experience. Learning, which can also take the form of learning from the environment through trial and error or by observing others, needs to be replaced with education because individuals aim to reach more than they already know, and their sense of curiosity does not lead them to the systematic information they seek. Ertürk (2017) defined education as the process of intentionally creating desired behavior change in an individual's behavior through his/her own experience. Demirel (2020) defined

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education as the process of changing behavior in the individual, and Demirel and Kaya (2020) defined it as the sum of the processes in which the individual acquires skills, orientation and other behavioral patterns that have the value of practice in the society s/he lives in. Kıroğlu (2020) defined education as nurturing people with knowledge and raising them in order to bring out the possibilities in people.

Based on the different definitions emphasizing that education is a process, assessment and evaluation are needed to determine the point reached in the process, to decide on the quantity and quality of progress and learning, and to determine at what level the goals have been achieved. Semerci (2015, p. 2) stated that “assessment and evaluation studies are needed in order to determine the knowledge, skills and competencies that individuals have gained in the learning-teaching process and the effectiveness of teaching practices”. The data obtained as a result of assessment and evaluation form the basis of decision-making on subjects such as teaching, grading processes, student selection and placement, and the effectiveness of curricula.

Central examinations, one of the tools of assessment and evaluation, provide information about the students' success and are also conducted in order to place students in certain institutions by evaluating them in terms of academic success. In other words, central exams aim to create more homogeneous environments by ensuring students with similar academic success study in the same institutions or departments. The central examination, defined as the preparation of exam questions and the national implementation of standardized tests, is one of the tools used in the systematic monitoring and evaluation of the performance of central and national education systems, schools, and students (Eurydice, 2009).

In China, France, Israel, Georgia, Japan and Turkey, central selection and placement exams are held to select students for higher education institutions. Namely, a secondary school student has to take the test to study in an upper-secondary school, or an upper-secondary school student has to take it to be able to study in a university. These examinations are organized by the Student Selection and Placement Centre (OSYM). The entrance examinations are carried out by the Ministry of National Education (MEB). Students with high scores are selected for central upper-secondary school, for example, Science Upper-Secondary School, Social Sciences Upper-Secondary School, and Anatolian Upper-Secondary School. These schools are referred to as qualified upper-secondary schools for secondary school students,

The names of the central exams 8th-grade students in the secondary school entered and the way they are implemented have undergone some changes in the last 15 years. In order to place 8th-grade students in upper-secondary schools after secondary school, the Secondary Education Institutions Selection and Placement Exam (OKS) was applied as a central exam until 2007. In 2008, this exam was replaced by the Placement Examination (SBS). In 2013, the name and application were changed as the Transition from Basic Education to Upper Secondary Education (TEOG) exam, which includes one exam in each semester and two exams in total in an academic year of the 8*th* grade. In 2017, the Upper-Secondary School Entrance Exam (LGS) was introduced, in which only secondary school students who want to study in qualified upper-secondary schools enter, and there is no obligation to participate in the exam.

This system also allows students who do not want to take the exam or who do not have sufficient success level in the exam to make a school choice based on their residence address. In the 8th grade central exam (LGS), candidates are asked a total of 90 multiple-choice questions from 6 courses: Turkish, Mathematics, Science, Religious Culture and Moral Knowledge, Social Studies, and English (MEB, 2022).

Güler (2019, p. 71) defined the type of test as a multiple-choice test, in which the answers are not given by the respondents; the correct answer is given among the options by the test preparers and the respondents are asked to find the correct answer, among options. Yılmaz (2015, p. 153), on the other hand, defined multiple-choice tests as tools that are designed to measure certain characteristics of the individual and consist of a certain number of items (questions) or procedures for everyone who takes it. High reliability and validity, ease of scoring and objective evaluation are among the advantages of multiple-choice tests that enable them to be used in central exams. In addition, when the number of people to whom the exam will be administered is large, multiple-choice tests should be implemented (Güler, 2019). In 2021, "1,038,492 of 1,243,830 students studying in the 8th grade of secondary school applied to enter the central exam (LGS)", (MEB, 2021).

The fact that the number of students taking the exam has reached levels that cannot be estimated may mean that it is getting harder and harder to gain access to a qualified upper–secondary school. The importance attributed to central examinations is in terms of the successful entry to an upper-secondary school and then university, and opportunities to good business. The high academic achievement expected from students can change the expectations of school administrators, parents and even students from teachers, so everyone who has an interest in exams wants teachers to give exam-oriented lessons. These requests sometimes increase the responsibility of teachers and even create heavy pressure on the teacher. According to Buyruk (2014), since the performance of teachers is evaluated in direct proportion to the success of the students' exams, the exam-oriented expectations of parents and school administration can put pressure on teachers. Due to the expectations and pressures, sometimes teachers can ignore/abandon the curricula that are the guide of the educational process.

However, it can only be through curricula to provide individuals with the knowledge, skills, and behaviors that they may need in their lives, appropriate to the requirements of the age, and to ensure that people are raised in accordance with the desired goals (Kalaycı and Yıldırım, 2020). Because the curriculum is an arrangement of experiences that covers all the activities related to the teaching of a course that is planned to be given to an individual at school or outside the school (Demirel, 2020, p. 6). Görgen (2019) expressed a curriculum as a plan that covers all activities related to the teaching of the course, such as objectives, content, learning-teaching activities, materials, and evaluation. Curricula that serve as a framework by determining the scope and boundaries of educational activities may cause teachers to go out of the framework or abandon the curriculum for some reasons. Some teachers could be flexible in their curriculum implementation, using some parts of the planned curriculum while omitting other parts (Superfine et al., 2015). In other words, teachers may have to give up their commitment to the curriculum due to school management, parents, students or other reasons.

In the literature review on the subject, studies (Buldur and Acar, 2019; Çetin and Ünsal, 2019; Kahraman, 2014; Ormancı et al., 2018; Özkan and Özdemir, 2014; Şad and Şahiner, 2016) that include teachers' views on central exams and their effects on curriculum implementation have been found. In some studies (Buyruk, 2014; Smyth, 2008; Superfine et al., 2015) it has been mentioned that teachers abandoned the curriculum. In some other studies (Bay et al., 2017; Burakgazi, 2019; Bümen et al., 2020), the factors affecting teachers' curriculum commitment have been researched. In some studies (Budak, 2015; Hondrich et al., 2016; McNeill et al., 2016; Piasta et al., 2015), the effect of personal variables on implementing the curriculum has been searched. After reviewing the literature, it was seen that many studies have been conducted about teachers' ignoring, abandoning or partly implementing the curriculum. However, the reasons that drive teachers who teach courses that are tested in the central exams to abandon the curriculum have not been studied. Thus, it was decided to conduct this research.

Aim

The aim of this research was to examine the reasons that lead subject teachers (Turkish, Mathematics, Science, Religious Culture and Moral Knowledge, Social Studies, and English) who teach in the 8th grades of secondary school to abandon the curriculum. For this purpose, interviews were conducted with the teachers to examine the reasons that pushed them to ignore/

abandon the curriculum. Also, the following questions were intended to be examined to clarify the reasons that lead teachers to abandon the curriculum.

1. What are the central exam-based reasons that lead teachers to abandon the curriculum?
2. What are the curriculum-based reasons that lead teachers to abandon the curriculum?
3. What are the student-based reasons that lead teachers to abandon the curriculum?
4. What are the reasons stemming from school administrators that lead teachers to abandon the curriculum?

Research Methodology

Model

This is a qualitative research study examining the reasons that lead the 8th-grade teachers to abandon the curriculum. The qualitative research process includes developing questions and processing steps, collecting data from the participants' own environments, performing inductive data analysis by reaching general themes from specific situations, and interpreting the meaning of the data by the researcher (Creswell, 2017). The research was shaped according to the case research pattern, which is one of the qualitative research types. According to Yıldırım and Şimşek (2021, p. 70), “the most basic feature of qualitative case research is the in-depth analysis of one or more cases”. In other words, factors related to a situation (environment, individuals, events, processes, etc.) are studied with a holistic situation.

Study Group

The study group consists of 15 teachers working in two separate secondary schools, one of which is affiliated to the private sector and the other is an official state school, in the 2021-2022 academic year under the Hatay Provincial Directorate of National Education. Criterion sampling, one of the purposive sampling methods, was used to determine the study group. As a criterion, teachers of 6 courses for which students are responsible for in central examinations (LGS) were selected. In addition, the weighted average coefficients of the courses in the exam were accepted as another criterion for the number of teachers interviewed. Information showing the weighted coefficients of the courses in the exam is given in Table 1.

Table 1
Subtest Weight Coefficients When Calculating Weighted Standard Score (LGS)

Section	Subject	Number of questions	Weight Coefficient
Verbal	Turkish	20	4
	T.R. Revolution History and Kemalism	10	1
	Religious Culture and Moral Knowledge	10	1
	Foreign language	10	1
Numerical	Maths	20	4
	Science	20	4

Codes such as T1., T2., T3., … T15 were used for the participating teachers in order not to include the personal information of the teachers in the study group or to keep their identities confidential in terms of ethics. Information showing the demographic characteristics of the study group is given in Table 2.

Table 2
Demographic Information of the Study Group

Code	Gender	Subject	Years of Service
T1	Female	English	10
T2	Female	Social Sciences	18
T3	Male	Science	8
T4	Female	Turkish	12
T5	Female	Turkish	9
T6	Female	Maths	14
T7	Male	Science	5
T8	Male	Maths	7
T9	Female	Religious C. and Moral K.	3
T10	Male	Science	4
T11	Female	Turkish	15
T12	Female	Maths	4
T13	Female	Maths	2
T14	Female	Science	6
T15	Female	Turkish	11

Table 2 shows the gender, subject, and years of service of a total of 15 teachers who participated in the research.

Instrument and Procedures

In the research, data were collected through a semi-structured interview form developed by the researcher. While preparing the interview questions, first of all, the literature on abandoning the curriculum was meticulously scanned, then interviews were held with the teachers who teach the courses related to the situation, and then a draft interview form was prepared. The questions in the prepared draft form were finalized by taking the opinions of 3 faculty members working in the education programs and teaching department and making the necessary corrections in terms of meaning. Afterwards, a pilot scheme was conducted with 2 field teachers in order to confirm that the questions in the interview form were clear and understandable. School administrators and teachers were also consulted in terms of time and place suitability, and interviews were held with the participants in the teachers' room and in the rooms determined by the school administration. In order to create an atmosphere of trust before the interview, the participants were given preliminary information about the subject of the research. Each interview lasted 10-15 minutes. After the interview, the answers given by the participants were written down and read to the participants for confirmation.

Data Analysis

All of the data collected in the research with written or audio recordings were transferred to the computer. All the data collected in the research were analyzed in depth using the content analysis technique. Yıldırım and Şimşek (2011) defined content analysis as presenting the data obtained by revealing unspecified themes, categories, and codes, and presenting them in a way that the reader can understand by bringing them together within the framework of themes and codes. In the research, the codes were obtained in detail with the researchers, 2 lecturers and 2 teachers, and appropriate themes were created within the framework of the codes obtained.

Reliability and Validity

The prerequisite for ensuring validity and reliability in qualitative research is to conduct the research in an ethical manner (Merriam, 2013). For this reason, interviews were held with the participants on a voluntary basis without any coercion in order to fulfil the ethical requirements. The necessary information about the research was explained, and the personal information of the participants was kept confidential. T1, T2, T3, ... T15 codes were given to the teachers participating in the research according to the order of the interview. The codes obtained from the interview data were converted into tables and the answers given by the participants to the questions in the interview form were used as direct quotations in order to present the research situation as it was. In the research, 2 researchers coded independently and the compatibility between the codes was determined by the reliability formula of Miles and Huberman (1994);

$$\text{Reliability} = \text{Consensus} / \text{Consensus} + \text{Disagreement}$$

By using the formula, the agreement between the coders in the research was calculated as 0.85. Reliability calculations over 70% are considered reliable for research (Miles and Huberman, 1994). Therefore, the result obtained in the research can be accepted as reliable for the research.

Research Results

When Table 3 is examined, the teachers participating in the research stated that they deviated from the curriculum due to the fact that the students took the central exam (LGS). The teachers mentioned that they did exam-oriented studies in their classes, solved new generation questions, and repeated the subject through multiple-choice questions, they said that the exam was an anxiety and stress factor for students, the exam was challenging for students, it measured only cognitive abilities and prioritized academic achievement. In addition, in the findings obtained, one participant mentioned that the central exam was necessary, while another participant expressed that the exam served its intended purpose.

Table 3
Central Exam-related Reasons that Lead Teachers to Abandon the Curriculum

Theme	Code	Participant	*f*
Central Exam	Exam-oriented studies	T1,T2,T3,T4,T5,T7,T8,T10,T12,T13	10
	New generation questions	T4,T5,T6,T11,T12,T13,T15	7
	Retests	T1,T4,T5,T7,T14	5
	Affective domain, anxiety, stress	T1,T4,T8,T11	4
	Compelling	T2,T4,T6	3
	Cognitive skill, academic success	T11,T12	2
	Exam required	T2,T15	2
	The exam is suitable for the purpose	T9	1

Some of the teachers' views on the issue are as follows:

> *"Although the Science is an experiment-oriented course, we do more exam-oriented studies than experiments."* (T7).
> "*Since it is an important exam for their future, I take the exam in the center and do studies according to that."* (T12).
> *"I am trying to ensure that students solve a lot of new generation questions because the exam they will take is multiple choice."* (T11).
> "*I teach them how to solve the new generation questions that are too long, and I make them solve the sample questions that come out monthly."* (T6).
> *"I am trying to make sure that my students succeed in the exam, so I try to repeat the topic and give information about the type of question."* (T1).
> *"The exam is important for students to have a better future, but this creates extreme anxiety in children in this age group. This anxiety can also prevent exam success."* (T8).
> *"I think the exam is very difficult for students. They prepare the exam very difficult, causing students and parents to worry and feel anxious." (T4).*
> *"Although the exam is difficult, I believe that it is necessary for a good student to go to a good school."* (T2).
> *"I think the exam distinguishes well between those who know and those who don't."* (T9).

Based on the responses provided by the teachers in the initial question of the interview, it can be concluded that the teachers abandoned the curriculum in order for the students to achieve high academic success in the LGS exam, which is one of the most important central exams that shape the future of their students.

According to Table 4, the participants described the curriculum as a reason not to stick to the curriculum. The participants mentioned that the curriculum was insufficient for the exam, the questions asked in the exam were different from the ones intended to be taught in the course. Additionally, the curriculum was found to contain an excessive amount of intense and superfluous information, resulting in time constraints for the participants, so they had time problems in keeping up with the curriculum, and they focused on the topics that might be asked in the exam and taught other subjects quickly. In addition, they stated that they could not do the activities that should be done according to the curriculum because the physical and financial resources of the school were not suitable, and therefore, they had to make changes in the learning and teaching processes. One participant stated that the curriculum exhibited a lack of flexibility and failed to accommodate modifications in the course offerings.

Table 4
Curriculum-based Reasons that Lead Teachers to Abandon the Curriculum

Theme	Code	Participant	*f*
Curriculum	Insufficient	T1,T3,T4,T5,T7,T12,T13,T15	*8*
	Incoherent	T4,T5,T6,T8,T11,T13	*6*
	Time constraint	T2,T9,T12,T14,T15	*5*
	Content selectivity	T1,T6,T8	*3*
	Physical facilities of the school, learning and teaching process, lack of materials	T3,T14	*2*
	Rigid, inflexible	T12	1

The views of participants about the issue are as stated below:

> *"I think that the curriculum and the central exam do not overlap. While there are questions about interpretation and higher-order thinking skills in the exam, I think that the curriculum is a little shallower in this regard."* (T13).
> *"The fact that the History of Revolution course in the 8th grade is two hours per week and the course content is very much creating difficulties in covering all the subjects. If I teach according to the annual plan, there is no time to solve questions and repeat the content."* (T2).
> *"Curriculum and exam are not consistent with each other. Grammar questions are almost not included in the exams anymore, the curriculum should be renewed as there are more questions on thinking and understanding skills."* (T5).
> *"The curriculum is definitely not enough. A student who is preparing for the exam with the books given by the Ministry of National Education has difficulty in solving even half of the questions. Books that are not renewed in accordance with the examination system are too far from the proficiency level."* (T15).
> *"I think that the curriculum is not enough even if the exam is based on it. I consider some topics a waste of time and I don't spend too much time teaching them."* (T1).
> *"The students' prior knowledge is not at the required level. If I don't stick to the program and want to teach prior knowledge first, it is not possible to cover all the subjects this time."* (T12).
> *"I care about my students' active participation in the lesson by making experiments and observations, but unfortunately, I cannot do this due to the lack of laboratories in our school and the lack of materials."* (T3).

When Table 5 is examined, it is seen that the participants did not adhere to the curriculum for reasons related to the students. Teachers stated that as the exam time approaches, students' inclination to acquire new knowledge diminishes, resulting in a reduced capacity to concentrate on instructional material. Some teachers, on the other hand, talked about the students' desire to prove themselves by being successful in the exam, and they stated that certain pupils were consistently subjected to parental encouragement for achievement, often including comparisons with others. In addition, the teachers stated that they wanted to provide assistance to students with low economic income for exams at school, however, they ultimately abandoned the curriculum owing to increased rates of absence coinciding with the onset of warmer weather.

Table 5
Student-based Reasons that Lead Teachers to Abandon the Curriculum

Theme	Code	Participant	*f*
Students	Unwillingness to learn	T1,T3,T4,T12,T13	5
	Lack of motivation	T2,T5,T6,T11,T14	5
	The desire for success	T1,T8,T10,T13	4
	External pressure, environmental pressure	T5,T7,T8	3
	Socio-economic level	T9,T2,T14	3
	Absenteeism	T7,T9	2
	Climate effect	T5	1

Some of the teachers' views on this subject are:

> *"As the exam approaches, it becomes harder to teach new subjects because students always think about the exam they are going to take."* (T13).
> *"Students lose their motivation as the weather warms up; they do not want to study. In general, as the exam approaches, we focus on repetition and solve questions." (T5).*
> *"In my experience, as the exam approaches, students get bored, they want different activities instead of studying, but we have to think about the exam as well."* (T1).
> *"We express to our students that the exam is important, starting with the summer courses. They also study really hard because they want to be successful."* (T10).
> *"Working in a private school is more difficult because parents have more expectations from you and students. They want their children to get high scores and succeed, and they tell us this clearly."* (T8).
> *"Most of the students in our school have a bad financial situation, so they have a hard time getting sourcebooks. I also distribute photocopies to prepare students for the exam at my own expense as much as I can." (*T9).
> *"Most students stop coming to school after the second exam. In our conversations with parents, they say that they are studying at home, and now there is very little time left for the exam."* (T7).

One of the most important reasons that lead teachers to ignore the curriculum is the students, who constitute a significant component of the educational institution. Teachers who work hard for the success of students abandon the curriculum in order to accommodate the individual interests and exam-related demands of their students.

According to Table 6, there are a multitude of reasons why teachers abandon the curriculum due to school administrators. These are the expectation of high success in the exam from the teachers, the idea of creating a better public opinion on school by the help of the exam, the evaluation of teacher performance on the basis of the exam, environmental pressures from entities such as the National Education Directorates and parents. These pressures exerted by the school administration to teachers in order to attain elevated levels of achievement. In addition, some teachers stated that some school administrators are ambitious due to their personality traits, and they cannot tolerate failure, so they want teachers to do everything possible for success. School administrators who have a tendency to maintain the beliefs and attitudes they have developed towards methods that bring success in their teaching lives expect high success from teachers in the same way.

Table 6
The Reasons Stemming from School Administrators that Lead Teachers to Abandon the Curriculum

Theme	Code	Participant	*f*
School administrators	Expectation of success	T3,T5,T8,T13,T15	5
	Public opinion on school	T2,T4,T6,T11	4
	Performance evaluation	T8,T9,T10	3
	External pressures	T2,T10,T13	3
	Personality characteristics, ego	T12	1
	Beliefs, attitudes, unwillingness to innovation	T1	1
	Traditional approach	T12	1

The participants expressed their views with the following sentences:

> *"Our principal says that we need to improve the test averages of the students by holding meetings. At the meetings, we always discuss the test results and talk about ways to help them get higher scores."* (T3).
> *"They see us as a failing school because we have very few students who have won the exam, so we are trying very hard to change this perception."* (T6).
> *"Teachers who apply a lot of practice exams and tests are seen as teachers who try harder in the eyes of both the student and the administration. The decisions of the administration regarding these teachers are different."* (T8).
> *"Our parents always want their students to achieve high success, when there is the slightest decrease in success, they ask us why and then go to talk to the administration immediately. Our administrators also want extra work from us."* (T13).
> "*We are trying hard to avoid confrontation with the administration and parents and to keep the average success rate in the exams at a good level."* (T10).
> "*Our school is not very successful, our opportunities are limited, and the students do not study; although I do my best, our principal is not satisfied with the mathematics average."* (T12).
> "*When we do activities and have fun with the students in the lesson, they come to warn us on the grounds that there is noise. The school administration sees 8th graders only as those who need to study for the exam."* (T1).

When the findings obtained from the interviews are examined as a whole, it can be said that the reasons related to the central exam, curricula, students, and school administrators are the main reasons that lead the teachers to abandon the curriculum.

Discussion

The current study focused on examining the reasons for the teachers who teach the subjects in the 8th grade to abandon the curriculum. Based on the study findings, the majority of the teachers listed central exams as the primary reason for abandoning the curriculum. Zhao et al. (2016) in their study, reported that the College Entrance Exam (CEE) in China was the most significant barrier to curriculum implementation, as well. Regarding the 8th grade level, it was concluded in the research that the teachers made alterations in the teaching processes on the condition of preparing students for the central exam, solving new generation questions, and leaving some time for retests, and therefore they abandoned the curriculum. This result obtained from the research matches up with the studies by Kahraman (2014) on the effects of centralized exam practice and the research conducted by Ormancı et al. (2018) about science teachers' perspectives on the central exams for the transition to upper secondary education. They concluded in both studies that teachers lack curricular fidelity and shift the teaching process to be exam-oriented. In addition, in a study conducted by Atılgan (2018), the side effects of selection exams were researched, and it was concluded that there are side effects such as loss of purpose of school and curriculum, enrolling in exam preparation institutions outside of school, stress and pressure created by exams. Similar to this current study, in their studies on the negative effects of the central exam, Ilhan et al. (2021) deduced that teachers gave priority to the subjects in the exam and the question types related to these subjects by focusing on the test technique instead of the achievements in the curriculum. The reason for this might be that central exam success is regarded as more important than teaching the curriculum. However, in a study carried out by Adedoyin (2013) about university students' viewpoints on high-stake tests in Botswana, it was discovered that high-stake exams had little effect on school assessment or on the subjects included in the test content being prioritized. The unlike results obtained from this study and those of Adedoyin (2013) could indicate different education philosophies or systems of countries.

In light of the findings, another important reason that led teachers to do exam-oriented studies is that teachers realize the anxiety caused by the central exam in students; they also think that the exam is challenging, and the exam aims to measure only cognitive skills, one of the horizontal goals of education. As Spann and Kaufman (2015) put it, what high- stake tests can measure and count are isolated abilities, specific truths and functions, the least interesting and least important aspects of learning. Likewise, Öztürk and Aksoy (2014) and Özdaş (2019) have also reached similar results that support this finding. In addition, Özdaş (2019) mentioned the difficulty of the central exam in his research and concluded that as the demand for schools that admit students through the exam is high, the competition among students and therefore the anxiety levels of students increase, which may indicate that students are overly conditioned about the importance of the exam. Many students, particularly those at risk of failing, are experiencing the unintended repercussions of high-stakes testing at home in the form of stress and anxiety for both themselves and their families (Westfall, 2010).

The literature and this study indicated that some of the teachers found the curriculum inadequate and not very consistent with the exam, which could affect the rest of the students' lives at this level. The curriculum contained a lot of details and was intensive, and they mainly focused on the exam topics in the content selection and skipped the topics that weren't included in the exam. In a similar vein, Çetin and Ünsal (2019) concluded that teachers tend to teach the content of the exam instead of the content in the curriculum. Negative opinions of teachers about the curriculum itself, together with central exams, might oblige teachers to abandon the curriculum. On the other hand, in a study conducted by Kaşıkçı et al. (2015), they reported that the exam questions were generally prepared in accordance with the achievements of the science curriculum.

In the research, it was concluded that the activities in the curriculum could not be carried out due to the lack of physical conditions and materials in the schools. Therefore, changes were made in the learning and teaching processes, ending up with curriculum abandonment by the teachers. Özcan et al. (2018), in their study gathering the perspectives of teachers about the curriculum, concluded that schools exhibit physical and financial inadequacies, namely in areas such as laboratory facilities, availability of materials, and conducive environments for educational activities. Schools with access to sufficient human and material resources and affluent socioeconomic conditions can apply the curriculum to a degree that would be challenging or impossible for schools in low socioeconomic environments (Chaudhary, 2015).

The study revealed that, due to the students' desire for achievement in the major examination and the pervasive influence of parental and societal pressures, students exhibit a reluctance to engage with unfamiliar subject matter, focusing primarily on the classes and subjects directly relevant to the exam. For this reason, the study showed that in addition to the exam studies done to reduce the anxiety level of the students, the teachers abandoned the curriculum in order to support the students with low socio-economic levels who have difficulty in getting extra resources or books for the exam. The result obtained from this research also coincides with the study conducted by Bümen et al. (2020). In their study, Bümen et al. (2020) emphasized that the socio-economic characteristics of the school deeply affect the commitment to the curriculum. The motivation of teachers for this could be to enable students studying in economically deprived areas to compete with students from better-off backgrounds and boost their test achievement.

The tendency of students to be absent towards the end of the term, their unwillingness to attend classes other than the exam courses or their desire to continue their exam studies at home are also among the reasons that push teachers to avoid the curriculum. Moreover, considering the reasons related to the students, especially towards the end of the 2nd semester, students start to be absent from school with the warming of the weather in the province of Hatay, which has a hot climate in summers. It has been determined that there is an increase in absenteeism from school due to reasons such as lack of motivation, reluctance to learn, helping the family at work or finding a job and working in a workplace. Therefore, in the research, it was concluded that the teachers continued their lessons by teaching exam topics and including repetitions in their lessons in order to increase the motivation in the classrooms or to resist the reluctance to learn. Atılgan (2018) reported that the central exams for the transition between grades became a goal and school education became a tool to achieve this goal, and schools gave priority to the preparation of students for the exam, which is parallel to the findings of this study. In addition, in the same study, it was concluded that the school and the education program were ignored, and especially in the years when preparing for the exam, the school absenteeism of the students and the number of sick report absences from school increased.

As revealed in this study, another reason that led teachers to abandon the curriculum was school administration-related. From the data obtained in the research and the interviews with the school administrators, the majority of the school administrators want their students to attend qualified upper-secondary schools in the central exam taken by the 8th-grade students. This may be because school administrators see central exams as a measure of the school's success and believe that this will increase the school's reputation in the region. In addition, in the research, school administrators decide on teachers’ performance using the criterion of students' success level in the exam. Similar to this study, in a study conducted by Çetin and Ünsal (2019), it was suggested that school administrators evaluate teachers' success with students’ central exam results. Likewise, Buyruk (2014) concluded that central exams serve as an indicator for evaluating the performance of teachers.

The current study made it clear that reasons such as the parents' request from the school administration to focus on the central exam continuously and that they want the students to be constantly tested are among the environmental reasons that lead the teachers to abandon the curriculum. Parents expect school administrators to guide teachers about central exams (Ayaydın and Katmış, 2017). Also, in a study conducted by Yılmaz and Bülbül (2017), they supported the idea that parents demand from school administrators that only certain teachers teach students who will take the central exam and that these teachers attend their classes and prepare them for the exams.

The research also revealed that school administrators have continuous expectations of success from the school, teachers, and students due to their personality traits. It was concluded that school administrators, who aim to achieve success, ask teachers for student success in central exams or make suggestions on this point all the time, which is one of the reasons that leads teachers to abandon the curriculum. In addition, as stated in the findings, teachers abandoned the curriculum because of school administrators who defended the traditional education approach. This may be due to school administrators' assumption that learning-teaching procedures appropriate for new student-centered approaches that instructors want to incorporate into their lessons are unimportant for central test achievement.

Conclusion and Implications

The current study showed that there are various reasons why teachers abandon the curriculum. The results pointed to four major reasons, including central exams, students, curriculum, and school administrators based along with a wide range of sub-reasons for teachers to abandon, skip, or ignore the curriculum. The findings were mostly in line with previous studies and literature. In conclusion, teachers pick and decide what to teach from the prescribed syllabus or curriculum. With any intention or reason, no matter what, most of the teachers abandon the curriculum, leading to unintended consequences. Namely, abandonment of the curriculum may cause disruption of creative, critical, and inquisitive thinking skills intended to be acquired by students, and as a matter of fact, the constructivist educational approach, which is at the center of the curriculum, is being ignored.

Depending on the results of the current study, some crucial implications came out. Initially, by taking the opinions of the teachers into account, the reasons for teachers to abandon the curriculum can be eliminated by making the curriculum more functional and fully compatible with the exam content. Secondly, in order to prevent content selectivity in central exams, the content validity of central exams can be increased, and questions can be included from each course and each unit in the exam. Then, under the leadership of the Ministry of National Education, apart from class hours, additional lessons can be given regularly to 8th-grade students or all students who will take the central exams, and regular practice exams can be done without hindering the curriculum. Finally, in order to reduce the problem of absenteeism as much as possible, all students who attend classes almost all the time can be given both grades and privileges in another way to try to eliminate the problem of absenteeism.

Recommendations

This research was carried out with a certain number of teachers working under the Ministry of National Education in the province of Hatay. The research can be carried out next time within a broader framework in terms of cities or regions.

This research was carried out with the teachers of the courses that have questions in the central exams in the 8th grade of secondary school. The scope of the research can be expanded by conducting the next research with the teachers of the courses that have questions in the central exams in the 12th grade of upper-secondary school.

Declaration of Interest

The authors declare no competing interest.

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THE INTEGRATION OF 5E INQUIRY-BASED LEARNING AND GROUP INVESTIGATION MODEL: ITS EFFECTS ON LEVEL FOUR SCIENCE PROCESS SKILLS OF FORM FOUR STUDENTS

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Abstract

Studies found that the mastery of Level-4 Science Process Skills (L4SPS) among secondary school students is still relatively weak. Thus, the purpose of this research was to determine the effects of 5E Inquiry-based Learning and Group Investigation (I5E-GI) model on the five constructs of L4SPS, namely Identifying Manipulated, Responding, and Constant Variables, Forming Hypotheses, Making Observations, Making Inferences, and Defining Operationally. A teaching and learning (TL) module was developed to guide teachers in implementing the I5E-GI method for the five L4SPS constructs. The L4SPS Test Instrument was constructed to measure the level of L4SPS mastery at the end of intervention. The quasi-experimental research design was conducted on 180 Form Four students taking Core Science subjects. A total of three groups were assigned, namely i) 5E Inquiry-based Learning and Group Investigation method (I5E-GI, n = 60), ii) 5E Inquiry-based Learning method (5E, n= 60), and iii) Traditional Learning (TR, n = 60) in an urban secondary school in Sarawak, Malaysia. Data were analyzed using the inferential statistical tests of MANOVA, MANCOVA, ANCOVA, and effect size. The results showed that there was a statistically significant effect across the three groups of TL methods. There is a statistically significant effect of the I5E-GI method compared to the 5E and TR methods on the five L4SPS constructs. As for the effect size, the I5E-GI method provides a more significant effect size than the 5E and TR learning methods. Overall, the findings prove that the I5E-GI method has positive implications for the mastery of L4SPS among Form Four students.

Keywords: *5E inquiry-based learning, Form Four students, Group Investigation, level-4 science process skills*

Introduction

Science process skills are one of the two components of scientific skills students need to master in learning science. According to Gagne (1968), science process skills are the basis for learning science. These science process skills have become increasingly important and are made the objective of the science curriculum in South Asia (Ong et al., 2014). Many previous studies found that students' science learning at school is greatly influenced by their mastery of science process skills (Awelani, 2002; Bayir, 2019). There have been several studies conducted on the level of achievement of science process skills among students in Indonesia and Nigeria, and the findings from these studies show the low achievement of students in the science process

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skills (Ekon & Eni, 2015; Kusuma & Rusmansyah, 2021). Parallel findings were reported by Ismail (1998), Yew and Tajuddin (2015) and Wun and Sunita (2015), who observed that the overall performance of the acquisition of science process skills of Malaysian students was unsatisfactory.

The findings of Wun and Sunita's (2015) research on 150 Form Four students related to mastery of level-4 science process skills show that the overall level of student achievement is moderate in terms of identifying manipulated variables, responding variables, and constant variables, building hypotheses, and making observations, while a weak level is found in terms of making inferences and defining operationally. Among the reasons for the weakness in the mastery of science process skills are that students rarely practice scientific skills, the teaching style lacks emphasis on thinking skills as suggested in the Science curriculum; students are less exposed to science process skills; teachers themselves do not understand science process skills resulting in difficulties in planning lessons; teachers themselves are less confident because they do not know the characteristics of each science process skill and do not know how to combine both knowledge and skills in teaching and so on. This shows there are still weaknesses in the mastery of science process skills among students and teachers.

For secondary School A in Lawas district, Sarawak, Malaysia, the results of Form Four students entering 2020 for the Science subject were very unsatisfactory. This can be seen from the examination results for Form Four Science in March 2020, which is quite worrying, where the Average Subject Grade of the Science subject was found to be very low (8.75), which is close to 9.00. In addition, the analysis of the results of the March 2020 examination shows that only 20 (12.4%) students out of a total of 160 students passed the examination for the Form Four Science subject. Based on the analysis of the items that were made, the researcher found that the main cause of students failing in the Science subject is students being unable to properly answer the questions on paper Two in part A, which consists of Level-4 science process skills. Therefore, an intervention needs to be implemented so that the students can achieve better results and also to increase the average subject grade of Science subjects for the upcoming exams.

Therefore, in the context of this research, the researcher developed a module based on the 5E cycle inquiry-based learning model (I5E) and cooperative learning based on Group Investigation (GI) Model, which is also known as the I5E-GI Module to improve the Level-4 science process skills of students. The researcher applies the learning module developed as a medium to deliver content in the teaching and learning of the Science process skills. The 5E cycle inquiry-based learning model was chosen because there is an evidence from previous studies found that the science process skills of the students who used the 5E cycle inquiry-based learning model turned out to be better than students who received the conventional learning method (Simsek & Kabapınar, 2010). The same findings were also found with a group of students who followed the Group Investigation Model (Parinduri et al., 2017; Siregar & Motlan, 2016). Therefore, the effort to change the Science teaching and learning (TL) method from traditional to student-centred is necessary. Therefore, a research study on integrating the I5E-GI method was conducted to improve the level-4 science process skills of Form Four students.

Literature Review

Level-4 Science Process Skills

In general, process skills refer to the processing strategies that a person brings to solve problems (Satyaprakasha & Behera, 2014). Science process skills refer to skills that help science learning, appreciation of active learning methods, develop a sense of individual responsibility while learning, and increase the permanence of knowledge (Dogan & Kunt, 2017). In the

Malaysian Science Secondary School Standard Curriculum. Level-4 science process skills include five processes, namely controlling variables, making observations, making inferences, building hypotheses, and defining operationally (Curriculum Development Department, 2018). Controlling a variable is the process of converting a constant variable into a manipulated variable and specifying a new responding variable, while hypothesizing is describing an expected outcome of a designed scientific investigation. Next, observing is a process where qualitative and quantitative observations are made to make generalizations based on patterns or sequences of objects or phenomena and present the results of further observation of objects or phenomena in an analytical and specific manner. Making inferences is the process of generating various possibilities to explain a complex situation. Defining operationally explains the interpretation made about the choice of equipment or method about what is observed.

Several literature studies show a positive relationship between students' science process skills and their achievement in Science (Aktas, 2013; Cakir, 2017; Ozturk & Dokme, 2015). Therefore, Science teachers need to be aware of the importance of improving students' science process skills. However, previous studies have found that students can not use science process skills appropriately (Burak, 2009; Lue, 2020). In the context of Malaysia, Lue (2020) found that students in Malaysia experience difficulties in mastering science process skills such as defining operationally, interpreting data, stating inferences, and making predictions. This situation may occur due to the science process skills applied among students happening indirectly while students are carrying out activities (Rauf et al., 2008). In addition, among other factors is due to the activities in the laboratory, especially those carried out by students, are guided by a list of instructions from the teacher or textbooks, and the student's understanding of the science process skills is not emphasized by the teacher (Sembak & Abdullah, 2017). According to Karamustafaoğlu (2011), science process skills are very important for students to gain meaningful learning because learning occurs continuously throughout life, and each individual is always looking for, interpreting, and evaluating the phenomena and problems they face daily.

5E Inquiry-Based Learning Model

Inquiry-based learning is one of the pedagogical approaches to learning that combines various elements of 21st-century learning. In this approach, learning is based on questions and questions to unravel the topic studied. Guided by the title, some questions are constructed, and then activities are carried out to answer those questions. Inquiry-based learning can be implemented by using various models according to the appropriateness of related subjects, and one of the general models that are suitable for implementing inquiry-based learning is the 5E learning model (Curriculum Development Department, 2019). The 5E Model, also known as the '5E Learning Cycle', is a model built using constructivist learning theory through an inquiry approach that is carried out to create an effective TL session (Yuksel, 2019).

There are five phases that need to be followed in the 5E Inquiry-Based Learning Model, namely engagement (engage), exploration (explore), explanation (explain), development (elaborate), and evaluation (Curriculum Development Department, 2016). In the engagement phase, the teacher stimulates students' minds to arouse students' curiosity, introduce context, and unearth students' existing knowledge. The exploration phase includes students building an understanding of concepts based on hands-on activities, conducting guided or open investigations to answer questions that have arisen, finding information/data using various sources, and carrying out investigations. Next, in the explanation phase, students develop explanations and extension ideas through reflection on the exploration that has been carried out, and the teacher gives input to check the understanding of the concepts that the students have formed. The development phase involves students developing their understanding of concepts through application in new situations, and the evaluation phase takes place in each phase to assess student development and encourage students to evaluate their understanding and abilities.

Previous studies have often shown that using the 5E Model can help improve student performance in Science subjects. For example, intervention research conducted by Abdi (2014) on primary school students in Kermanshah, Iran, showed that students exposed to the 5E inquiry learning approach were more successful and highly understood Science subjects. Campbell (2006) found that students' knowledge of science concepts increased by using the 5E learning model. Karsli and Ayas (2014) in their research stated that there was an increase in the percentage of students' science process skills test results because students were trained to use science process skills such as scientifically observing, formulating hypotheses, determining variables, interpreting data, and presenting experimental results in explanation phase.

Cooperative Learning - Group Investigation Model

The cooperative learning method is a teaching strategy where students help each other in small groups (Mohamed, 2012). Yahya and Bahuri (2010) stated that the number of members for this cooperative learning usually consists of four to six members, and this cooperative learning requires students to be responsible for the learning of their teammates in addition to their learning. Aziz and Bustam (2011) also agreed that in cooperative learning, students need to help each other in groups to achieve academic performance. This is in line with previous studies where, apart from cooperation, cooperative learning emphasizes the achievement of team goals and success. This can be achieved when all members of the team give the necessary commitment (Esa & Mahbib, 2014).

According to Asma (2006), Group Investigation Model (GI) is defined as a cooperative learning model where students seek information (ideas, opinions, data, and solutions) from various sources (books, institutions, and people) inside and outside the classroom. Students evaluate and synthesize all the information each group member presents and finally produce a group product. In this research, cooperative learning through GI means that students learn together in small groups to complete the given task. Students are divided into groups of four people only. Each group member is given his/her responsibility, and the success of the group members depends on each other. This means that the more skilled students guide and help the weaker students in the group and work together to achieve the maximum level of learning and not just for themselves. This research follows the six steps of GI suggested by Suardi (2015): planning, investigation, organizing, presenting, and evaluating.

Most of the findings from previous studies show that the GI model of cooperative learning positively affects student learning. A research study by Suartika et al. (2013) concluded a difference in the understanding of science concepts between students who followed the GI and those who followed conventional learning. Meanwhile, the research of Dewi et al. (2012) also stated that the GI model can improve learning outcomes and student activities on chemicals in food for Science subjects. Siregar and Motlan (2016) and Parinduri et al. (2017) also found that students who followed the GI model performed better in science process skills than students who followed conventional learning.

Integration of 5E Inquiry-Based Learning and Group Investigation in Level-4 Science Process Skills Learning

In this research, the researcher integrates the 5E inquiry-based learning model and the Group Investigation (GI) model to cultivate Level-4 science process skills. The 5E Learning Model refers to the five phases of learning, which are Engagement, Exploration, Explanation, Development, and Evaluation, while GI requires students to explore and acquire knowledge through group learning, which consists of six steps, namely planning, investigation, organizing, presenting, and evaluating. During the Engagement phase, the teacher attracts students' attention by using various methods, such as watching videos or providing situations related to the topic to be learned in the lesson. Students respond and engage actively. Then, students are divided into several groups based on the first step in the GI, which is grouping. Each group consists of four members. Assignments are given to each group after group division. Students answer Level-4 science process skills questions after conducting an investigation.

At the Exploration phase in the 5E cycle inquiry-based learning model, the group leader explains the task to each group member. Then, students discuss in groups and plan the steps to investigate the assigned task. Like the planning step in a GI, the group leader assigns tasks to each group member to carry out the exploration. Students discuss the strategies that need to be used together. During the discussion, students identify manipulated variables, responding variables, and constant variables. In addition, students also learn from group members who are more skilled in creating hypotheses for experiments that are conducted. After planning, the investigation is carried out in groups, and all members are actively involved in the investigation step. At the same time, each group member makes observations on the experiment's results and is able to express those observations correctly. Students are also able to analyze the data obtained based on the results of experiments and group discussions. Group members help each other to complete their assignments. So, skilled members guide weak members when analyzing data, such as making inferences and defining operationally. Teachers monitor and help students from table to table.

The organizing step in GI requires group members to produce their assignments to be presented in the presenting step. This presenting step is also parallel to the explanation phase in the inquiry-based learning model of the 5E cycle, i.e. the students explain the results they get in various ways determined by the teacher, whether it is a presentation in front of the class or a Gallery Walk and the question and answer session takes place afterwards. During this explanation or presenting step, students try to learn and consolidate knowledge about the Level-4 science process skills learned while in the group through presentations from other groups. Other students ask the presenting group questions, and the presenting groups answer the questions addressed openly.

Improvements to the results of each group's answers are made. Next, each group is given a new situation or task at the Development stage in the inquiry-based learning model of the 5E cycle. Students discuss and answer the Level-4 science process questions and display their answers. Students ensure they have mastered Level-4 science process skills by answering the questions given. They ask for guidance from more skilled friends. Finally, the Evaluation stage in the 5E cycle inquiry-based learning model and GI allows students to ask questions, reflect on the learning that has been carried out, and make corrections to the assignment. Finally, the closing stage requires students to conclude the learning gained.

Research Purpose

This research aimed to examine the effects of integrating the I5E and GI methods, namely the I5E-GI method, using a 5E cycle inquiry-based learning module and cooperative learning based on explicit GI. The operational definition of Level-4 science process skills was based on the Curriculum Development Division (2018) of Form Four Science which is Identifying Manipulated, Responding, and Constant Variables, Building Hypotheses, Making Observations, Making Inferences, and Defining Operationally. Specifically, the research questions are as follows:

Will the students taught using the I5E-GI method produce a higher post-test mean score compared to students taught using the I5E method and the Traditional learning method in the mastery of Level-4 science process skills i) Identifying Manipulated, Responding, and Constant Variables, ii) Constructing Hypotheses, iii) Making Observations, iv) Making Inferences, and v) Defining Operationally?

Research Methodology

Research Design

This research used a quasi-experimental quantitative approach that only involved pre-tests and post-tests. In this research, the quasi-experimental research design was based on unequal groups (Campbell & Stanley, 1996) and did not involve a random selection of respondents (Fraenkel & Wallen, 2008). This design is always used when it involves research on the effectiveness of a teaching method, module or program in various situations that a pure experimental design cannot be applied, especially in real situations at schools (Chua, 2011; Mok, 2010).

Population and Sample

The population of this research consisted of 400 students from four schools in Lawas district, Sarawak, Malaysia. In this research, the researcher used purposive sampling to select a sample based on several criteria. According to Reinard (2001), the researcher needs to use judgment to choose the most suitable respondent for his/her research. Therefore, the sample was selected based on the specific purpose of the research, and the researcher selected the sample based on the experience and knowledge of the sample groups to be taken (Cohen et al., 2011). In this research, Form Four students at national secondary school A in the Lawas District were selected as the research sample. School A was chosen after considering several things, namely: 1) School A has a similar socioeconomic background of students; 2) School A does not group students into high- and low-achieving classes but combines high-achieving and low-achieving students in one class; 3) school selection has considered various other indicators that are considered important (Marshall & Rossman, 1995) such as getting cooperation and permission from School A to carry out the research, having good facilities such as laboratories; and 4) the quality and credibility of the research data obtained is guaranteed by considerating the energy, financial costs, and school hours are appropriate for the research period. Overall, the sample of this research involved 180 students who were randomly selected from six classes in School A, where each class consisted of 30 students as an intact group. Two classes received the complete treatment of the learning method based on the 5E inquiry-based learning and GI model (I5E-GI, $n = 60$), while the other two classes only received treatment based on the 5E Inquiry-based Learning Model (I5E, $n = 60$). The remaining two classes received Traditional Learning (TR, $n = 60$). All 180 students were given the intervention in the same week but with different TL methods for six weeks between October – November 2021.

Instrument

In this research, an instrument was developed, which is the Level-4 Science Process Skills (L4SPS) Test. This instrument has evidence of good construct validity and reliability assessed using the Rasch Measurement Model (MPS) based on the findings of a pilot research involving 60 students.

Level-4 Science Process Skills Test (L4SPS)

The L4SPS instrument is a structured test developed by the researcher based on the Form Four Science content about Level-4 science process skills. The L4SPS instrument contains five constructs and 26 items: 1) Identifying Manipulated, Responding, and Constant Variables (7 items) – Example: “State the variables in this experiment.”; 2) Building a Hypothesis (5 items) – Example: "State a hypothesis for this experiment."; 3) Making Observations (3 items) – Example: "State an observation about the diameter of the indentation in Figure 2.2."; 4) Making Inferences (5 items) – Example: "State the inferences that can be made based on the observations in 3(b)(i)."; and 5) Define Operationally (6 items) – Example: “Based on this experiment, state the operational definition of inertia.”. The content of the L4SPS question set for the pre-test and post-test is the same. However, the researcher made changes in terms of item position and some item stimuli without disturbing the meaning of the item. This is intended to make the given question look like a new question (Mohamed, 2012). The pre-test and post-test use the same set of questions to measure the extent of the student's development and improvement in mastering the requirements of the questions. The suggested time to answer was 1 hour 30 minutes, equal to three minutes for each question.

In this research, the validity of the L4SPS instrument was tested based on item fit analysis using Rasch Measurement Model. Three criteria can be used to evaluate the item fit (Boone et al., 2014), namely: 1) Outfit Mean Square Values (MNSQ) – the value range is between 0.50 and 1.50; 2) Outfit Z-Standardized Values (ZSTD) – the value range is between -2.00 and 2.00; and 3) Point Measure Correlation (PTMEA-CORR) – the value range is between 0.40 and 0.85. Findings from the evaluation of item fit analysis indicate that all items in the L4SPS instrument have accepted a range of Outfit MNSQ and ZSTD values. Meanwhile, all items in L4SPS have a positive PTMEA-CORR value. This is supported by Bond and Fox (2015), who stated that an item with a positive PTMEA-CORR value means that it measures the intended construct. In addition, for the reliability of the L4SPS instrument, which was also analyzed using Rasch analysis, the index value for item reliability (0.76) and the reliability of the research subject (0.73) were good and acceptable.

Data Analysis

Several inferential statistics, namely Multivariate Analysis of Variance Test (MANOVA), Analysis of Covariance Test (ANCOVA), and Multivariate analysis of covariance (MANCOVA), were used in this research to answer research questions that aim to examine the effect of the TL method (independent variable) which is I5E-GI, I5E, and Traditional Learning on the mastery of Level-4 science process skills (dependent variable). MANOVA was used to analyze the comparison of TL method groups using the mean scores obtained from the pre-test. This research used the pre-test of Level-4 science process skills as a covariate before the intervention. MANCOVA was used to evaluate the effect of three different TL methods on the post-test of Level-4 science process skills after the intervention by controlling for covariates. Suppose the overall MANCOVA results are statistically significant. In that case, the Univariate F test (ANCOVA) was conducted on the post-test mean score with the pre-test mean score as a covariate to assess further whether there was a statistically significant effect of the TL method on each post-test. In addition, the effect size (d) and partial Eta Square (η^2) were also used to measure the strength of the effect by referring to the value suggested by Cohen (1998), where $d<0.2$, $0.2\leq d<0.5$, $0.5\leq d<0.8$, and $d\geq 0.8$ refer to very small, small, medium, and large effect sizes, respectively. While for the interpretation of η^2, $0.010\leq\eta^2\leq 0.039$ is small, $0.039<\eta^2\leq 0.110$ is moderate, and $0.11<\eta^2\leq 0.20$ is large. Before testing the multivariate statistical findings, the researcher has conducted a preliminary analysis to assess whether the prerequisite assumptions of MANOVA/MANCOVA have been met, such as multivariate normal distribution, equality of covariance, linear relationship between the covariate and the dependent variable, multicollinearity, and homogeneity of the variance of the dependent variable (Tabachnick & Fidell, 2019). In this regard, all prerequisite assumptions of MANOVA/MANCOVA were met before data analysis was carried out to answer the research questions.

Research Results

Table 1 shows the descriptive statistical analysis results of the pre and post-test for the Level-4 science process skill constructs. Based on Table 1, it was found that there was an increase in the mean score of students who followed the I5E-GI and I5E methods for all constructs in science process skills. In addition, an increase in the mean score was also seen in the group that followed the traditional learning except for the construct of Identifying Manipulated, Responding, and Constant Variables, where there was a decrease in the mean score in the post-test.

Table 1
Descriptive Statistical Analysis of Level-4 Science Process Skills Constructs

Construct	TL method	*N*	Pre-test		Post-test	
			M	*SD*	*M*	*SD*
Identifying Manipulated, Responding, and Constant Variables (MRC)	I5E-GI	60	1.789	0.852	3.811	0.701
	I5E	60	1.767	0.936	3.033	0.765
	TR	60	1.550	0.867	1.267	0.756
Building Hypothesis (BH)	I5E-GI	60	2.717	0.885	5.756	0.812
	I5E	60	2.550	1.016	4.800	0.925
	TR	60	2.717	0.804	2.883	0.667
Making Observations (MO)	I5E-GI	60	1.400	0.924	2.511	0.503
	I5E	60	1.283	0.922	2.033	0.765
	TR	60	1.267	0.880	1.383	0.904
Making Inferences (MI)	I5E-GI	60	1.067	0.880	3.667	0.983
	I5E	60	1.100	0.775	3.000	0.695
	TR	60	1.150	0.755	1.150	0.936
Defining Operationally (DO)	I5E-GI	60	1.900	0.933	4.922	0.738
	I5E	60	1.850	0.880	4.400	0.770
	TR	60	1.700	0.997	1.933	0.972

The results of the MANCOVA analysis in Table 2 show that there is a significant effect of the independent variable (TL method) on the dependent variable (science process skill constructs) [F(2, 176) = 31.819, $p < .05$]. This shows that the TL method impacts the mastery of the constructs of Identifying Manipulated, Responding, and Constant (MRC) Variables, Building Hypotheses (BH), Making Observations (MO), Making Inferences (MI), and Defining Operationally (DO).

Table 2
Summary of Multivariate MANCOVA and Univariate ANCOVA Test Results based on Teaching and Learning Methods

Effect (TL method)	MANCOVA			ANCOVA			
	Pillai's Trace F	*df*	*p*	*F*	*df*	*p*	η^2
MRC	31.819	2, 176	*p* <.05	1.305	2, 172	*p* <.05	.917
BH	31.819	2, 176	*p* <.05	208.033	2, 172	*p* <.05	.632
MO	31.819	2, 176	*p* <.05	40.833	2, 172	.012	.306
MI	31.819	2, 176	*p* <.05	1.727	2, 172	*p* <.05	.675
DO	31.819	2, 176	*p* <.05	13.475	2, 172	*p* <.05	.700

Further, an ANCOVA test was conducted to identify whether the independent variable (TL method) affected the dependent variables. ANCOVA analysis showed that there was a significant effect of the TL method on the construct of Identifying Manipulated, Responding, and Constant Variables [F(2, 172) = 1.305, $p < .05$, $\eta^2 = .917$], Building Hypotheses [F(2, 172) = 208.033, $p < .05$, $\eta^2 = .632$], Making Observations [F(2, 172) = 40.833, $p = .012$, $\eta^2 = .306$], Making Inferences [F(2, 172) = 1.727, $p < .05$, $\eta^2 = .675$], and Defining Operationally [F(2, 172) = 13.475, $p < .05$, $\eta^2 = .700$]. The ANCOVA analysis also shows that there is a high relationship between the TL method with the Level-4 science process skills constructs, where the I5E-GI method contributes 91.7%, 63.2%, 30.6%, 67.5%, and 70.0% to the mastery of the construct of Identifying Manipulated, Responding, and Constant Variables, Building Hypotheses, Making Observations, Making Inferences, and Defining Operationally respectively.

Post hoc analysis was also performed to determine the effect of the independent variable on the dependent variable. Table 3 shows the results of pairwise comparison tests and effect sizes for the effect of the TL method on the constructs of Level-4 science process skills. A pairwise comparison shows that the I5E-GI method is significantly higher than the I5E method for all constructs in Level-4 science process skills ($p<.05$). Meanwhile, the pairwise comparison also shows that the I5E-GI method is significantly higher than the TR method for all constructs in Level-4 science process skills ($p<.05$). The same findings are also seen in the pairwise comparison between the I5E and TR methods, where the I5E method is significantly higher than the TR method for all constructs in Level-4 science process skills ($p<.05$).

Table 3
Pairwise Comparison Test Results and Effect Sizes

Construct	Pair Comparison	*MD*	*p*	*d*	Cohen's interpretation (1988)
MRC	I5E-GI vs I5E	0.78	*p* <.05	0.67	Big
	I5E-GI vs TR	2.54	*p* <.05	1.01	Big
	I5E vs TR	1.77	*p* <.05	1.56	Big
BH	I5E-GI vs I5E	0.96	*p* <.05	0.81	Big
	I5E-GI vs TR	2.87	*p* <.05	1.31	Big
	I5E vs TR	1.92	*p* <.05	1.76	Big
MO	I5E-GI vs I5E	0.48	.002	0.67	Big
	I5E-GI vs TR	1.13	*p* <.05	1.01	Big
	I5E vs TR	0.65	*p* <.05	1.56	Big
MI	I5E-GI vs I5E	0.67	*p* <.05	0.75	Big
	I5E-GI vs TR	2.52	*p* <.05	1.51	Big
	I5E vs TR	1.85	*p* <.05	1.86	Big
DO	I5E-GI vs I5E	0.52	*p* <.05	0.77	Big
	I5E-GI vs TR	2.99	*p* <.05	1.21	Big
	I5E vs TR	2.47	*p* <.05	1.46	Big

For effect size analysis, the findings of the research found that students who followed the I5E-GI method showed a significant effect size compared to the I5E method for all constructs:- Identifying Manipulated, Responding, and Constant Variables, Building Hypotheses, Making Observations, Making Inferences, and Defining Operationally, each has a Cohen's d value of 0.67, 0.81, 0.67, 0.75, and 0.77. The findings also show that students who follow the I5E-GI and I5E methods show a larger effect size than the TR method for all constructs in Level-4 science process skills. Statistically, the I5E-GI method effectively improves the mastery of students' Level-4 science process skills.

Discussion

Integration of 5E Inquiry-Based Learning and Group Investigation (I5E-GI)

In this research, the I5E-GI method is proven to be more effective than the I5E and Traditional Learning methods in increasing the mastery of Level-4 science process skills constructs among Form Four students, particularly in the construct of Identifying Manipulated, Responding, and Constant Variables, Building Hypotheses, Making Observations, Making Inference, and Defining Operationally. The findings of this research are consistent with Piaget's Theory of Cognitive Development (Piaget, 1964) and Vygotsky's Theory of Social Constructivism, which states that social interaction is a force in mental development (Vygotsky, 1978). Effective learning is through communication skills (Wan Husin et al., 2016), creativity and collaboration skills (Ayob et al., 2015), critical thinking skills, and problem-solving skills (Bell, 2010). While communicating with group members, students will obtain new information from other students and exchange information during the exploration process. According to Aziz and Andin (2018), teaching should be carried out actively to apply thinking skills in student learning.

In this research, activities in the I5E-GI Module promote productive interaction among Form Four students with different knowledge backgrounds, where intelligent and proactive students act as experts. Students explore new knowledge together through positive interaction and effective communication among group members. Integrating group investigation with I5E allows students to learn independently, safely and respectfully among group members (Johnson & Johnson, 2009). This situation encourages students to develop their Level-4 science process skills through learning activities carried out in groups. This kind of cooperative learning aligns with Vygotsky's theory, where students allow each other and their friends in the group to give their opinions during the discussion to plan the investigation. During the discussion process, the weak students and the expert students exchange information, and the weak students get guidance on determining the variables from the expert students.

Based on the I5E-GI module, students in groups also plan and carry out joint investigations under the guidance of the group leader. The group leader ensures that each group member has mastered the construct discussed before moving on to the next construct. Meanwhile, weak students ask for guidance and follow guidance from expert friends. Form Four students in the I5E-GI group are also actively involved in the group by discussing solutions or information for activities that have been planned, as in the I5E-GI module, with peers. Students with lower achievement than other members are helped by friends to make a complete picture with unique and interesting information and understand the meaning of each Level-4 science process skill. The nature of openness to the ideas and views of each student forms a positive practice in acquiring knowledge. The results of this research are supported by Gillies (2003), who suggests that students exposed to cooperative learning are exposed to different relationships, such as giving and receiving help, learning other people's perspectives, expressing their views, and finding new ways to solve problems.

The I5E-GI Module contains six hands-on activities, lasting about three hours each, so students have more fun while learning. Students also better understand the concepts learned by conducting investigations in groups because students can discuss with others. The findings in this research align with the learning theory proposed by Piaget and Vygotsky, who consider interaction with peers to be an important factor in improving cognitive and social development (Gullo, 2006). Therefore, students need to adapt to others in the group and interact effectively to build self-understanding. Learning based on the 5E inquiry-based and Group Investigation model successfully enriches students' knowledge and improves Level-4 science process skills. This finding is also proven by Karsli and Ayas (2014) in a research study which found that the increase in the percentage of students' science process skills test results occurred because students were trained to use science process skills using the 5E learning model such as scientific observation, formulating hypotheses, determining variables, interpreting data, and present the experimental results in the explanation phase.

The implementation of I5E-GI learning is suitable to form a TL environment that is active and not passive, as demanded in 21st-century learning. This is because I5E-GI learning is one method that allows students to learn and teach each other. Somasundram and Mahamod (2017) support this finding through their research, proving that cooperative learning encourages students to teach and learn among themselves. The discipline of knowledge and responsibility in understanding, mastering, and re-explaining to other friends indeed helps produce students who are responsible, actively seek knowledge, and have good communication and social interaction with the demands of 21st-century learning.

5E Inquiry-Based Learning (I5E)

On the other hand, students who only follow the I5E method are not exposed to cooperative learning. The I5E method used in this research only requires students to act on their own and carry out all investigations individually with less emphasis on group work. This causes students to have less opportunity to discuss in groups and less to communicate with other students. In addition, they also do not share opinions and listen to criticism from other friends compared to the group of students who follow the I5E-GI learning method. Learning that is implemented individually will cause students' critical thinking to be less developed, so students are weak in giving reasons and solving problems (Klimoviene et al., 2006).

According to Rissi (2010), when students are not actively involved in activities such as solving problems and exchanging ideas, they cannot develop abstract thinking or see their sketches more deeply and diversely. Furthermore, the students who were taught with the I5E method alone lacked an understanding of how to implement group investigation throughout the learning process. In this research, passive students will act as observers who do not contribute to problem-solving and generate ideas. Kagan (1992) agreed that when groups do not organize equal participation, group discussion sessions only involve participation exclusively by high-performing students. Passive students will act as observers who do not contribute to producing sketches and products. Thus, I5E learning without GI is less satisfactory and effective in improving Level-4 science process skills among students when compared to the I5E-GI method.

Traditional Learning (TR)

The teaching that uses the TR method obtained the lowest post-mean scores compared to the I5E-GI and I5E methods at the end of this research. The TR teaching method only relies on the teacher to deliver information during the TL process, and the students only act as receivers. This situation shows that students are not actively involved in group activities or discussions and that TL is teacher-centred. A supportive learning community, as suggested by Johnson and Johnson (2009) and Kagan (1992), is lacking within the TR learning group for the development of Level-4 science process skills. Thus, students are completely dependent on the teacher to obtain new knowledge and information, and it is difficult for students to learn hands-on Level-4 science process skills. In other words, students who follow the TR method do not discuss and share information with other students. Specialists are not needed because only teachers are referred to if there are any problems or questions. In the TR method, teaching is singular, where the teaching process is focused on teachers. Students become passive in the classroom, and this causes students to become listeners and put the teacher at the centre of learning. Indirectly, knowledge becomes limited, and resources are lacking. Students also do not have the opportunity to think and present their own opinions. As a result, their freedom to creatively explore ideas is somewhat limited to sharing ideas or resolving contradictions between their perspectives or with other students. Therefore, students in the TR learning group did not foster as much Level-4 science process skills as students who had participated in the I5E-GI and I5E learning group.

Conclusions and Suggestions

This research aims to answer research questions about the effects of I5E-GI in improving the mastery of the five Level-4 science process skill constructs among Form Four students. The results of the research have shown the positive effect of the I5E-GI method in improving the five Level-4 science process skill constructs, i.e. i) Identifying Manipulated, Responding, and Constant Variables, ii) Constructing Hypotheses, iii) Making Observations, iv) Making Inferences, and v) Defining Operationally. This clearly shows that integrating the I5E-GI method that assimilates 5E inquiry-based learning and group investigation-type cooperative learning has been a catalyst and factor in increasing student mastery of Level-4 science process skills more effectively.

However, only the topics in the Form Four Core Science syllabus that include experiments were selected in this research. The findings of this quantitative research explain the effects of the I5E-GI method based on the difference in the mean scores of the pre-and post-test. For future studies, it is suggested that qualitative data is also collected through observation, document analysis of student work, and interviews with students involved in the research. With that, the findings of extended research can provide a more detailed explanation of the extent to which the implementation mechanism of I5E-GI affects the research variables.

This research involved only 60 students per teaching method, and may not be representative of the secondary school students' population as a whole. The data in this research were collected after 18 hours of students' learning experiences to analyse its effects quantitatively. Future research will need to employ a larger sample size and a longer period with extra learning activities compared to the current research to extensively assess the learning effects of the I5E-GI method in science lessons.

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Declaration of Interest

The authors declare no competing interest.

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CORRECTION ON THE OPINIONS AND NEEDS OF SCIENCE CENTER INSTRUCTORS: THE CASE OF GOKMEN SPACE AND AVIATION TRAINING CENTER (GUHEM)

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Abstract. Erratum for "Aslan, A. (2022). The opinions and needs of science center instructors: The case of Gokmen space and aviation training center (GUHEM). *Problems of Education in the 21st Century*, *80*(6), 792–810. https://doi.org/10.33225/pec/22.80.792".
Keywords: erratum

This document presents the changes belonging to the published article (p. 802).

The following changes were added in the manuscript titled "The opinions and needs of science center instructors: The case of Gokmen Space And Aviation Training Center (GUHEM)" which was published in Volume 80, Issue 6, https://doi.org/10.33225/pec/22.80.792

Table 8
Instructors' Opinions During Visits

Theme	Codes	Instructors	*f*
Interaction	Having people of various styles	I2	1
	Visit of crowded groups	I3	1
Not encounter any difficulties		I1, I4, I5, I6, I7, I8, I9	7

According to Table 8, the majority of the instructors indicated that they did not experience any issues or that the work did not go wrong during their visits to GUHEM. However, I2 and I3 coded instructors stated that sometimes the expectations of the visitors are quite high and partially less interaction with the students, especially in crowded school groups. Instructor responses to this code are as follows:

> "It can be challenging to simultaneously please each guest in the same way. We can meet people of varied styles and see how some people approach things differently. This can occasionally cause difficulties. (I2)", "Reducing interaction with students in school groups through intensive visits and attempting to convey information by competing with time. The fear of "influencing"

> the participant takes precedence over the motivation to provide information and the participant's curiosity. (I3)".

The last question in the opinion form is, "As an instructor, are there times when you feel incompetent in leading visitors to GUHEM or when you want professional assistance?". Table 9 shows the themes, codes, and frequency values defined based on the instructors' responses to this question, which are then supported by sample quotations.

Table 9
Situations in Which Instructors During Visits

Theme	Codes	Instructors	*f*
Situations	Scope of specialisation	I3, I4, I5	3
	Spesific or off-topic questions	I8	1
	Visit of large groups	I2	1
No situation affecting the functioning		I1, I6, I7, I9	4

According to Table 9, during the visits to GUHEM, the trainers drew attention to several issues. Some of these issues are as follows: giving feedback in specific subject areas appropriate to the age and knowledge level of the visitor; difficulties in controlling large groups of visitors; and unexpected questions (outside the subject area) from the visitors. Some examples of these situations are given below:

> "It is sometimes difficult to dominate large group visits (with small age groups). (I2)", "Aviation and biochemistry are topics that I, as an astronomer, have little knowledge of. I think that I have a limited amount of knowledge in this area and, more importantly, I think that I should use different methods to pass on my existing knowledge to people from all walks of life and of all ages. (I3)", "Indeed, specific or off-topic questions can be asked when visiting. (I8)".

This article is an erratum for "Aslan, A. (2022). The opinions and needs of science center instructors: The case of Gokmen space and aviation training center (GUHEM). *Problems of Education in the 21st Century*, *80*(6), 792–810. https://doi.org/10.33225/pec/22.80.792".

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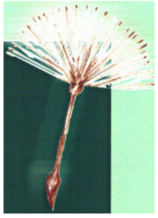

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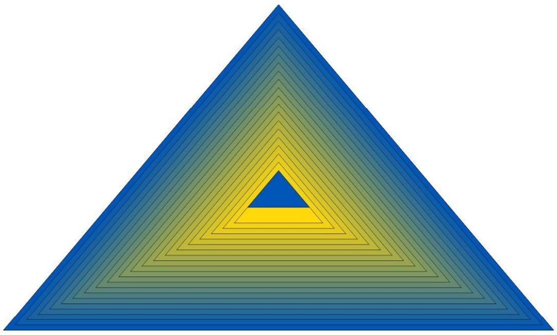
...'Educational systems, like any other, change over time, i.e., they are dynamic. It is necessary to evaluate this property in the future development perspective of the system. Educational systems form (are formed), develop intensively, experience collapse. In all phases of the system development, an important thing is – its ability to adapt to the environment. From a methodological point of view, it is very important to analyse the state of a specific system at various stages (phases) of its development. We often say that education must be systematic. But what does this mean? Unfortunately, a deeper understanding is sometimes lacking. It is important to emphasise that all parts and elements of the education system should be included to the maximum extent and perceived as integral parts, seeking the established common goal'. ...



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